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*The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.*

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## BRIEFLY TOLD.

PLACE FOR HOLDING THE NEXT ANNUAL MEETING OF THE OHIO GAS LIGHT ASSOCIATION.—Last week we had occasion to say that the "postal card vote of the Ohio Gas Light Association, on the proposition to hold the next annual meeting of the Association, during the time of the Exhibition, instead of in Ohio in March, resulted in an emphatic affirmative." In supplement of that announcement, as we are informed by Mr. A. P. Lathrop, Secretary of the Association, it has been determined by the Executive Committee of the Association to hold the next annual sessions in New York, on Wednesday and Thursday, February 3d and 4th. Mr. Lathrop is preparing an official notification for the members of the decision reached.

THE MILLER PAPERS.—In our abstract of the proceedings of the last meeting of the American Association, published to day, will be found two papers, on subjects that are quite apart as to their matter. One of the articles is by Mr. Alten S. Miller, the Engineer of the New York and East River Gas Company, whose subject was "The Separation of Water Gas Tar." He treated his theme altogether from an eminently practical standpoint, and in such manner as to leave no room for doubt that his plan of separating the tar was satisfactory to him. In the discussion that ensued those who participated therein might be forgiven for holding that Mr. Miller did not place a very high value on the material thus separated, but that it is growing in favor for certain uses cannot be denied; and we venture the prediction that the time is not far distant when none of it will be used for fuel, for it will be in demand at prices well above those quoted at present, despite the fact that the "all-round tar trust" is about as omnivorous as it is well organized—and it certainly is both. We regret that Mr. Allen, of the Mutual Company, of New York, was not on hand to take part in the discussion, for his system of separating water gas tar always appealed to us as representing simplicity itself. The Miller plan, however, differs but little from the Allen system. The second paper is by Mr. W. S. Miller, of the Cincinnati Gas Light and Coke Company, whose singularly clear assembling of the details of construction of the Cincinnati Company's carbonizing plant is certain to be read with pleasure and profit. That he possesses mechanical knowledge and training are not to be disputed; that he has the faculty of setting out his thoughts for easy transcription through ink to paper may not be denied. We regret that our abstract of the discussion is such a flimsy one, but that which is possible to short-hand reporting is not permitted to long hand "noting," if clearness and fairness of and to the speakers were the objects, and as the nature of the speeches was such that figures and details were very much in evidence, it was better to suppress those that could not be reported, rather than garble them. The paper was a most interesting one.

PREPAYMENT METERS AS A "SHORT TOPIC."—Our abstract also contains one of the "Short Topics" for discussion, which "topics" were submitted for the first time this year, as an aid to evoking useful discussion. If we mistake not, the thought or idea respecting the "Short Topic" contributions originated with ex-President C. J. R. Humphreys, and, in common with the membership at large, he should be well pleased over the useful and abundant measure of success which the innovation obtained. The short topic given this week was submitted by Mr. C. W. Blodget, of the Williamsburgh branch of the Brooklyn Union Gas Company, who reported some experiences with prepayment meters. Although the "topic" as presented by him consisted of only four paragraphs, it was nevertheless of sufficient length to bring out a sharp discussion. Perhaps the prevailing force of the discussion went to show that the matter of the practical use of prepayment meters was not of common fame in this country as yet. However, the debate also proved that such a state of affairs would not long exist here, since the questions that were asked by those who had not tried them rather proved that all were ready, if not anxious to make the trial. There is no longer any doubt as to the practicability of the measurers, nor as to the fact that a profitable field for their use exists in all of our gas consuming communities. Indeed, within the past two years a great many prepayment meters have been placed by the New York city companies—notably, the Consolidated—and while many difficulties initially encountered in adapting the meter to the needs of the situation in New York were met, that they have been surmounted would seem to be shown in that the use of the meter is increasing. It is now a question of detail and practice, to fit the meter to the needs of the varying communities in which it is to be used, rather

than a question of whether the meter is fitted to the duty that it is to be relied upon to fulfil. So, in that view, we imagine the meter makers will be very busy in this direction in the twelvemonth before us.

MR. WILDER'S COMPLIMENTS TO THE SUGGESTIONS OF MR. SWINDELL, OF BALTIMORE.—This comment just precedes some caustic paragraphs, by Mr. M. G. Wilder, of Philadelphia, on an "item" that appeared in our issue for last week, concerning certain advice, given through the public press of Baltimore by Mr. Swindell (the official gas inspector of that city), to gas consumers who wished to be possessed of knowledge enabling them to cut down the gas pressure shown at their burners. Neither our correspondent nor ourselves supposed for a moment that any of our readers would take our report of what Mr. Swindell said seriously; indeed, the inspector's advice was printed merely to show how far a public official might advance over the line that separates official duty from official excess of zeal. We would supplement Mr. Wilder's criticism by remarking that the gas industry often suffers, in common with other enterprises that sustain relations to the public, by reversals in politics. For instance, Mr. Swindell, for political reasons alone, was appointed to his present position last summer (in July, we think), and he succeeded a man who was thoroughly competent in all respects for the position. But as we must partake of that which the gods provide, we will have to stand Mr. Swindell until he learns something more about the business he has in hand—or until another political reversal puts him where his predecessor is. Another instance of this unfortunate sort is afforded in our item columns of to-day. In them it will be found that the official gas inspector of Detroit, Mr. C. H. Krecke, has been superseded by another incumbent, the reason for the change being baldly given that he enjoyed the work and reaped the salary of the position for "a long enough" period—just two years! What more need be said?

## Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

### Mr. Wilder on Some Advice Given to the Gas Consumers of Baltimore, Md., by the Official Gas Meter Inspector of that City.

THE WILDER MANUFACTURING COMPANY,
816-822 CHERRY STREET, PHILA., PA., Nov. 24, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL:

My attention has been called to a communication from your correspondent at Baltimore, Md., published in your issue for November 23d, in which is included some remarks by Mr. W. H. Swindell, official inspector of gas meters, etc.; also directions given by him, and published in the Baltimore *News*, whereby gas consumers could check the rate of consumption of gas, by partly closing the service cock through which gas is supplied to the house pipes, having first turned on and lighted the average number of burners that are used.

It seems almost incredible that at this time, when you can hardly take up a magazine or paper without seeing therein some mention of improvements in gas lighting apparatus, and when there is such a continual display of those improvements in every direction, that any one charged with the official supervision and testing of meters should make such a recommendation. It is clumsy, and, under the conditions, entirely ineffective for the purpose. Has he not learned that the pressure changes, and that there is hardly a period of 25 minutes in the evening when the pressure is uniform? What becomes of his reduction of gas bills when fewer burners are lighted than when the service cock was set? Is he going to keep running to the meter as the pressure changes? I think not.

Seriously, Mr. Editor, it is about time that someone should call a halt upon the publication of such stuff—not for the benefit of gas men; they know better and are not misled by it. But there are considerable numbers of gas consumers who do not know, and who would receive it as the truth, coming, as it does, from one in a position of authority.

In these days of Welsbach lights, governor burners and other improvements in gas lighting and gas burning devices, all resting upon a scientific basis, and all of them so common that the wayfaring man, though a fool, need not err therein, I cannot allow such a misleading publication to pass without protest. There are methods for correcting excessive gas bills that operate perfectly, whether one burner or 100 burners are burning, and regardless also of changes of street pressure. It is not necessary, therefore, to resort to so shallow a device as that proposed. As I do not know, and had never previously heard of Mr. Swindell, I have, therefore no motive in this except to point out the mistake made by the official sealer and inspector of gas meters of the city of Baltimore. I am, respectfully, MOSES G. WILDER.

[ABSTRACT OF PROCEEDINGS.—Continued from page 813.]

## TWENTY-FOURTH ANNUAL MEETING, AMERICAN GAS LIGHT ASSOCIATION.

HELD IN THE PLANTERS' HOTEL, ST. LOUIS, MO., OCTOBER 27, 28 AND 29, 1896.

SECOND DAY, OCTOBER 28—MORNING SESSION.

Mr. Alten S. Miller, of New York, read the following paper on

### THE SEPARATION OF WATER GAS TAR.

The title of this paper is to a certain extent a misnomer, as any tar that is formed during the making of carbureted water gas from hard coal or coke comes not from the water gas, but from the oil used in carbureting. It is intended to briefly outline a simple and inexpensive method of separating this oil residuum or tar from the water with which it is mixed as it comes from the scrubbers, condensers, seals, drips, etc.

When gas oil or heavy residuum is used for enriching in the generator-superheater process, and the gas leaves the superheater at about 1,450° F., about 8 per cent. of the oil used is recoverable as a very fluid tar, the specific gravity of which, at 60° F., is about 1.090. The oil residuum from the retort processes is apparently lighter than water and requires different methods of separation from the tar made by the generator-superheater apparatus. The latter will be considered exclusively.

The difference between the gravity of the tar and water is quite sufficient to insure complete separation of the two, if there were no disturbing causes; but, at temperatures below 140° F., the tar and water seem to have a slight affinity, and emulsions, having as much as 66 per cent. of water, will stand almost indefinitely without separation. The whole secret lies in bringing the mixture to a temperature of 160° F. or over and allowing it to stand or flow slowly.

In the ordinary gas works making water gas exclusively, it is advisable to collect the drainage from the washers, scrubbers, condensers, and all drips in a set of pipes that have no connection with the overflow from the holder tanks or any other source of water supply.

Such being the case, the temperature will easily be kept high in the trunk drain to which all these flow. At some convenient and easily accessible point this trunk drain is run into a tar separator. This separator is made by putting a partition across a tank, reaching from the top to about 30 inches from the bottom. The overflow should not be less than 6 feet above the bottom, and the tank may be deeper with advantage. The tar and water run into the tank on one side of the partition, and the water runs out of the overflow on the other side after having passed under the dividing partition. Tanks 6 feet deep, and having a capacity of 3 gallons per 1,000 feet of gas made in 24 hours, have been found to work very satisfactorily.

Inasmuch as the temperature cannot always be kept uniform, some tar will at times find its way beyond the separating tank, so it will be found advisable to put in one or two tanks like the first. The water will then flow from No. 1 into No. 2, and thence into the drain or No. 3.

If the separator is kept at a temperature of 160°, almost all the tar will separate from the water, and scarcely a trace of water will be found in the tar in the bottom of the separator. Between the tar and water will be found an emulsion of tar and water 12 inches or more thick, and in draining off the tar care must be taken not to let the emulsion come with it. After water shows at a test cock 18 inches above the bottom of the separator, no more tar should be drawn. Attempts have been made to take advantage of the difference in gravity between tar and water to make an automatic overflow, but thus far with indifferent success.

The best way to control the temperature of the separator is by controlling the temperature of the entering water. If part of the condenser water is used in the scrubbers and washers and the rest used for the boilers or some other purpose, there is no difficulty in properly cooling the gas, and, at the same time, keeping the separator at 160°. No more water is needed in the washer than is necessary to keep it sealed. If possible the hot water from the scrubbers should be used for the washers, otherwise the warm water from the condensers. Very little, if any, water is needed in the scrubbers, and this can be had warm from the condensers. By exercising a little care the waste water from the apparatus can be delivered at the separator at 170° to 180° F. If for any reason the apparatus cannot be so operated as to keep the waste water hot, the separator can be kept warm by a small coil of pipe in the bottom, through which live or exhaust steam is forced. In the case of two

or more separators in series, the steam will be needed only in the first one. It is well in any case to put the steam coil into the bottom of the separator, as it can then be heated when the plant is started up after being shut down for some time. It is well to cool the overflow water and use it again for scrubbing and washing, as it has in solution a large amount of hydrocarbons, and its capacity for hydrocarbon vapors is thus very much diminished.

If there is any water in the tar it can very easily be seen by running a little of it on a piece of common window glass. If no water is present the film is smooth and uniform, but if water is present it shows in small globules through which light can be seen. I have here a sample of tar free from water, and others containing 1, 2, 3, 5, and 40 per cent. These percentages were obtained by adding water to the pure tar. Sometimes in testing, small air bubbles looking very much like water will collect, but these can easily be broken and made to disappear.

Several years ago, when this same subject was before this Association, Mr. David Douglas stated that he had been able to make a good and satisfactory varnish out of this tar. Beyond this I know of no uses to which it has been put other than those for which coal tar is commonly used. I have made a few experiments with it, but have never had the time necessary to push them far. I hope that the members present will give us the benefit of their experience, and so add much that is valuable to the sparse and unsatisfactory literature on the subject.

*Discussion.*

Having finished reading the paper, Mr. Miller said that the specimen of tar shown, and which was labeled "pure tar," was obtained from the separator, and was not a result of distillation. Other specimens before them were composed by adding specified quantities of water to the pure tar. The sample labeled "tar free from water," shows it as taken finished from the separator. The figures given for the size of separator were, of course, arbitrary, but the size noted worked very well for him. He thought, however, that members wishing to experiment would do well if they increased the dimensions of the separator instead of curtailing them.

Mr. Egner declared the paper was of much importance to him, because at Norfolk, Va., heavy oil was being used in the water gas apparatus, with the result that some tar was being produced, and Mr. Miller's plan showed him a meams of separating it.

Mr. G. T. Thompson said he was at a loss to know what became of the light oils that formed in filmy shape over the water and tar. He did not know of any instance in which such films had been separated.

Mr. Robert Young asked if he were right in the thought that some of the samples shown were taken from the well, after the settling had been effected. If so, and were water added again to the tar, would the resultant mixture be equal to that before any separating had been tried?

Mr. Rusby, in answer to an invitation from the President to take part in the discussion, remarked that Mr. Miller had put the case so plainly that little was left to be said in further explanation. He (Mr. Rusby) then gave some details respecting the method of separating employed at the Jersey City (N. J.) works, a point in the apparatus there that was much in its favor being an arrangement for causing the hot water to fall on an iron plate some 2 feet below the point where the hot mixture made its exit. He did not separate the mixture to the last possible point, and the quantity of tar obtained was equal to about 1¼ gallons per 1,000 feet of gas made.

Mr. Ramsdell asked if there were a good market for water gas tar, and how the price received compared with the price received for coal tar.

Mr. Egner then recounted an experience gained by him in connection with water gas tar, when acting as Engineer for the Standard Gas Light Company, of New York city. The Health Board refused to permit the Company to allow the drainage from the condensers and scrubbers to pass into the Harlem river, so the Company was put to great expense to construct receptacles for the drip, which was afterwards taken out in barrels, the contents of which eventually found their way into the sea.

In closing the discussion, Mr. Miller, replying to Mr. Thompson, said he did not have light oils or films of that sort in his water gas tar, although he had been operating the separator described for more than a year. Replying to Mr. Young he said he had not experimented much in the line of adding water to the tar, but he must confess that he had to shake it so that it would look as it then appeared. They all knew that the "tar combination" was a pretty compact organization, and that its methods were such that it could come close to naming the prices it would pay. He thought, however, that it should be worth in any event 1¼ cents per gallon around the district of New York city, otherwise he would use it as fuel. For the latter purpose it should be worth 1⅛ cents a gallon. Then, too, if a part of it were sold and a part of it burned, the practice would result in curtailing the market supply to a point sufficient to perhaps cause the loss on the first account to be more than recouped by the increased price received on the second account.

On motion of Mr. Nettleton, a vote of thanks was passed to Mr. Miller.

The President said there was sufficient time before recess to take up one of the "Short Topics," the presentation of which was designed to bring about short discussions on particular subjects. The suggestion was agreed to, and the President asked Mr. C. W. Blodget of Brooklyn, N. Y., to read the Topic prepared by him, the subject of which was

PREPAYMENT METERS.

At this point Mr. Egner said—Before Mr. Blodget reads his communication I wish to call the attention of the Association to the fine drawings sent by Mr. Edward Drory, of Berlin, and by Mr. W. R. Herring, of Huddersfield, England. Had I applied to them as an individual for the information which they sent me on the subject, I feel I would have been of too little consequence to be even replied to; but when I wrote to the gentlemen I told them I desired the information to enable me to prepare a paper to be read before the American Gas Light Association, and they very generously responded by sending me the drawings before you—there were also some other sheets which I forgot to bring with me. Mr. Herring also sent the album which is here. I am sure he would not have done that for me personally. I wish, therefore, to move a vote of thanks to Mr. Edward Drory, the General Manager of the Imperial Continental Gas Associations Works in Berlin, and to Mr. W. R. Herring, of the Huddersfield Corporation Works; and that our Secretary be instructed to inform the gentlemen of these resolutions. (Seconded by Mr. A. C. Humphreys and adopted.)

Mr. Blodget then read as follows:

Some three years ago the Williamsburgh Gas Light Company, of Brooklyn, N. Y., determined to try the experiment of introducing the prepayment meter, and, after a year's delay, succeeded in obtaining a limited number.

All of these meters were set practically without solicitation; in fact, a time arrived when the inquiry for same was discouraged. The reasons for such a course are not relevant to this topic and cannot with propriety be mentioned here.

Our experience with the prepayment meter is clearly delineated by the following statistical picture. The average size of all meters set in the district equals a 5-light, and the monthly consumption of gas approximates close to 2,000 cubic feet per meter. Of the whole number of meters set 63 per cent. are 3-lights, the users of which consume a mean of 900 cubic feet per month each. Those who have availed themselves of the prepayment meters burn on an average 1,700 cubic feet every month, showing an increase of, roundly, 89 per cent. over the amount consumed in the regular 3-light meter, and being about 15 per cent. less than the average of all the consumers.

A comparison of the accounts of those who formerly used the ordinary meter, but who now have a prepayment measurer, shows that, with the latter, there has been an average increased consumption of 23 per cent.

*Discussion.*

The President, in calling for discussion on the topic in hand, hoped that those present who had tried the prepayment plan would report their experiences so gained.

Mr. Littlehales asked whether any change had been made in the price of gas so supplied to make up for the greater cost of the prepayment meter as compared with the ordinary meter.

Mr. Blodget replied that the Company charged a uniform rate of $1.25 per 1,000.

Mr. A. S. Miller said he had done something in the line of placing prepayment meters in Long Island City, N. Y. Some 25 or 30 3-lights were put in houses piped for gas, the residents of which, however, had not been burning gas. He induced the occupants to try the prepayment meter by urging them to remember that they could use gas or not, and that the cost to them of the gas they would use was entirely under their own control. The placing of the meter would not cost them anything. Almost all to whom I spoke agreed to try the plan, and although the meters have not been in use for a period long enough to allow of a final verdict in the premises respecting average consumption per month, and so on, it seems to me that the average consumption through the prepayments will be fully up per month to the average consumption shown by our ordinary 3-light regular meters in use. I

believe that the business thus secured will be both satisfactory and profitable.

Mr. Ramsdell asked Mr. Blodget if the demand for the meters emanated from the consumers, or if the Company secured the placing of the same through solicitation.

Mr. Blodget replied that the meters were put in at the request of consumers. The Company rather discouraged the plan.

Mr. Raynor said that in Adrian, Mich., they started in with the prepayment meter in 1894. The first one was put in a barber shop that had been lighted with oil lamps; two Welsbach burners were also put in when the meter was placed. The very next day a second meter was put in, also in a place where oil had been used—in fact, their subsequent experience was that prepayment meters were usually put in houses and shops that had been lighted by oil lamps. In some cases, of course, the prepayments replaced ordinary meters, and often we find that customers seem well enough satisfied to pay us greater sums per month for gas under the prepayment system than they did when their supply came through the regular meter, and when they paid their bills monthly. We are satisfied with the results so far, and shall continue to place the prepayments.

Mr. Neal asked Mr. Blodget how frequently the meters were examined and the cash collected. Also, whether shortages as to gas supplied and money deposited were often discovered.

Mr. Blodget said that the meters were examined each month, and the money was collected at the same time. Their practice was to have someone connected with the household present when the money box was opened. Only on two occasions was a shortage discovered. On one other occasion they found two iron pieces in the box. Whenever anything that looked like fraud was discovered the meter was taken out at once. As a rule, the money received was rather in excess of the equivalent in gas used. We hold the consumer responsible for the condition of the meter and for the cash that should be in the money box as shown by the dial indicated consumption.

Mr. Raynor said the ordinary practice at Adrian was to grant a discount of 10 per cent., but the supply through prepayment meters was based on a fixed gross rate. The meters were inspected monthly, and the returns were kept in a manner similar to the practice followed in keeping the returns from ordinary meters. He had very little complaint to make about discrepancies between the sum in the box and the registration on the dials. When a discrepancy did exist, the consumer and the Company usually settled their differences without much fuss or argument.

Mr. Cowdery thought the discussion so far rather tended to prove that the average gas consumer was honest. Their experience at Milwaukee, where two prices existed for a fuel and illuminating gas supply, also went to prove the assertion about the gas consumer's honesty.

Mr. Robert Young thought an advantage of the prepayment meter to gas companies was that it enabled them to take on a class of consumers which they otherwise could not secure—he referred to those who could expend a matter of a quarter, say, but who could not seemingly afford to run up a monthly bill for gas that amounted to more than four times that sum. The thing was when they put in their quarter, they knew that was the end of the expenditure, unless they saw fit to go on again in like manner.

Mr. Nettleton said that practically he did not know much about prepayment meters, for he had only within a short time made his first purchase of them. Theoretically, however, he might claim to be better posted, in that he had read much of the literature on the subject, which reading caused him to favor the meter very much. He thought the prepayment meter would secure to them a class of consumers, who, even if their use of gas was comparatively lesser in volume than that of other consumers, were nevertheless worth trying for.

Mr. Egner hoped that the proprietors of his Company would authorize him to put out a few prepayment meters, and after they had been tried he would be glad to report the actual results. He thought there was a good field for them in Norfolk.

Mr. Raynor said he wished to remark, in addition to his former contribution to the discussion, that he made a point of it to put the prepayment meter in as conspicuous a position as possible in the houses or shops where it was used.

Mr. A. J. Boardman asked Mr. Blodget what was the least value of the coin used with his prepayment meters.

Mr. Blodget replied, "a nickel."

Mr. A. J. Boardman said he was much pleased at hearing the discussion brought out by Mr. Blodget's "short topic," for he thought there might be a profitable field for the prepayment meter with the people which his Company served in Tampa, Fla. There they had a great number of cigar makers, who changed their living quarters frequently; but as the houses were, as a rule, piped for gas, he thought a prepayment meter would suit the conditions of the gas supply and consumption rather better than an ordinary meter in the dwelling places of the cigarmakers.

Mr. Harbison said he had formed the idea that the usual, in fact general size of prepayment meter, was on the 3-light order, wherefore he had not tried them in Hartford. He would not buy an ordinary 3 light meter, believing that they were too small for even average lighting supply conditions. He might add, too, that they had discontinued the use in Hartford of service pipes one inch or under in diameter.

Mr. Blodget said he thought the meter makers could furnish prepayment meters of any measuring capacity ordered.

Mr. Littlehales thought Mr. Harbison might not be altogether on the safe side in declining to place any 3-light meters. In fact, he thought it was a serious mistake to put in a meter that was not quite close to the actual needs of the consumer.

Mr. Blodget closed the discussion by saying that the Company put in the services at its own expense. In fact, that had been the general practice of the Company for 12 or 15 years.

The President declared the meeting adjourned until 2 P.M., and notified the members that the concluding session would be held in the Directors' room of the Laclede Gas Light Company, as the hotel proprietors wished to arrange for the banquet in the parlors in which they had been holding the convention.

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### Second Day—Afternoon Session.

The Association reassembled at 2 P.M. at the place designated by the President before recess.

### Report of Committee on Next Place of Meeting.

Mr. Prichard, of the Committee on Next Place of Meeting, reported that the Committee favored New York City. Considerable discussion ensued, which was terminated by the adoption of a resolution (offered by Mr. Walton Clark) substituting Fortress Monroe, Old Point Comfort, Va., for the place named by the Committee.

Mr. William S. Miller, of the Cincinnati (Ohio) Gas Light and Coke Company, read the following paper on

## A MODERN RETORT HOUSE.

While in attendance at the meeting of the Ohio Gas Light Association, your able President made a thorough inspection of the new No. 5 retort house of the Cincinnati Gas Light and Coke Company, and regarding it more complete in all of its appointments than any he had seen, requested a paper descriptive of it to be read before this meeting.

Although this retort house contains some features essentially unique, its general plan would be adaptable with slight modifications to any locality where it should be desirable to have stoking machines to take the place of hand labor. As the most important feature considered in its design was that the operating floor should be placed at an elevation sufficiently high to preclude the possibility of having the benches submerged during the time of high water, it may be of interest to mention the conditions that have heretofore existed at such times in the Cincinnati works.

In the year 1884 the crest of the unprecedented flood in the Ohio river left its mark near the center of the top retorts at the West End Station (old works), registering a stage of 71 feet ¼ inch above low water mark. Operations were then suspended in the works for about 10 days, and as the city was without gas, lamps and candles were required where electric lights were not in use. The overflow ran in strong currents through the streets adjoining the gas works, and the employees were ferried to and from the works. Since that time we have been reminded annually of the experiences of that year by the visitation of flood water in the cellar of retort house. Although the water did not reach the grate bars of the benches, we were always apprehensive until it commenced to recede, lest it should attain a greater height than ever before.

The East End Station had been in course of construction for two years at the time of the flood in 1884, and the crest of the rise reached the floor of the retort house. The bench arches and the pier walls had been finished, and work commenced upon the construction of furnaces. After the subsidence of the flood, the company concluded that the retort house floor should be raised 3 feet, level with the top of the window sills. Making the change involved the tearing down and rebuilding of the pier walls and bench arches to correspond with the new floor level. The work progressed rapidly, and the manufacture of gas was com-

menced in the fall of 1884, since which time, had the flood contingency arisen and had the old works been shut down, sufficient gas could have been produced at the East End Station to supply all demands in February, the month of floods, the suspending of the lighting of the submerged districts being considered.

In 1892, with the average yearly increase in consumption, it was evident that the above condition would terminate within a few years, and prudence dictated that No. 5 retort house should be built at the old works, to have a capacity of 4,000,000 cubic feet per day, and to have its operating floor beyond the reach of floods. Unless the flood contingency was considered, a new carbonizing plant was not an apparent necessity, as prior to this time the old and new works had not been working to their maximum capacities.

Not having the available ground upon which to construct No. 5 retort house, the Globe Rolling Mill (adjoining the west side of works) was purchased. The lot had a frontage of 250 feet on Front street, and extended back 500 feet to the Ohio river. Having acquired possession of that property, the ground plan of the works was thereby shaped rectangular, being bounded by three streets and the Ohio river, with Front street passing nearly through its center, parallel with the river, thus separating the purifying buildings and gasholders from the carbonizing buildings, coke bins and coal storage sheds and yards.

was desired that it should embrace every new feature that would tend to facilitate and economize production, and that it should be as complete as possible in all of its appointments. To meet these conditions it was designed for the operation of the Ross steam charging and discharging machines; and, as the retort house best adapted to their satisfactory use was, in our judgment, the one at the East Station, the same general plan was adopted, incorporating therein all improvements that had been pointed out by actual practice and experience during the eight years it had been in operation. At the same time every necessary precaution was taken to avoid the risk of temporary suspension of operations in works at times of flood water in the Ohio river. The plans were mapped out by Gen. Hickenlooper, President of the Company, and the details and specifications in accord therewith were prepared by a local architect. Before work was commenced upon the foundation plans test holes were bored 50 feet apart, from the front to the rear of the lot upon which No. 5 retort house was to be erected. It was found that about one-third of the building would rest upon clay soil, and the remainder upon from 1 to 35 feet of ashes, slag and other rolling mill refuse. As the Company concluded to take every precaution to secure a good foundation, it was decided to drive 735 piles, varying in length from 30 to 45 feet, under all foundations that would otherwise have been supported by ashes.

**Fig. 6.**—Interior View of Retort House and of Stoking Machines, from Central Bridge.

The retort house at the old works contained 78 benches of 6's, equipped with regenerator furnaces, and two retort discharging machines. In the rear there were coke bins and coal yards. The coal supply was received in barges, and good facilities were provided for elevating and discharging it into coal sheds and yards. The coke was drawn into the cellar, and received into cars, upon tracks parallel to benches and leading to hydraulic hoists; it was thereby elevated and dumped into coke bins, from which it was loaded, after passing over fixed screens, into wagons for the market.

Taken as a whole, it was by no means an out-of-date plant as compared with many other large works. But the carbonizing expenses per thousand cubic feet of gas made were much greater than at the East Station, where, by the operation of the Ross charging and discharging machines, and by the complete system in vogue for handling coal and coke, labor was reduced to a minimum; and there was obtained an average yield per diem of 50,000 cubic feet of gas per man, including the machine men, lid men, furnace and coke men, and coal men, or, in other words, all labor required in handling coal and coke in the retort house and in depositing the residual coke into the storage bins. The coke used under the benches was seven (7) per cent. more than at the East Station, the saving of which, together with that due to the operation of stoking machines, would have been sufficient inducement to warrant the company in building a new retort house, even if the flood contingency were not considered.

In deciding upon the plan and construction of No. 5 retort house it

The dimensions of the building, 347 feet 6 inches in length by 110 feet in width, were determined upon by the following considerations: Size of retort, 15 inches by 25 inches by 9 feet 6 inches inside measure; number of retorts in each bench, 9; width of the benches from center to center of pier walls, 11 feet; thickness of the back walls of the benches, 1 foot 6 inches; width of the stack, 21 feet; number of benches, 52, 26 benches of nines being about the maximum number one pair of the machines can serve; space required for the operation of the machines between the face of the benches and the columns supporting the coal bins and the main roof, 19 feet 6 inches; span of main roof truss, from center to center of the supporting columns, 61 feet; gauge of machine tracks, 8 feet 6 inches; space required between the ends of the benches and the front and rear walls of the building to allow for the passage of the machines from one side of the house to the other, 20 feet; the total length of the bench walls from the north to the south end of the building, including an arched passage way in the center of the house, 301 feet 10 inches. Four turn tables, 14 feet in diameter, are provided, one being located at each end of the trackways. The cellar floor is about 2 feet above the street in front of the building, and 14 feet 6 inches below the operating floor. The tops of the coal bins are 25 feet 6 inches above the operating floor; on the same level, at each end of the house, there is a gallery, and in the center a bridge, supporting trackways upon which coal cars are run when delivering coal into the bins. In each of the corners of the building there are machine rooms in which all repairs are made upon the stoking machines. The walls of the machine

rooms are carried up sufficiently high above main roof to inclose water storage tanks, and are topped out as square towers.

All sub-foundations consist of a heavy bed of good concrete, dimension limestone imbedded in cement mortar and limestone water table, the top of which is level with the floor of the basement. The basement walls are built in piers of large dimension limestone laid as range work, the thickness of the courses of masonry gradually decreasing in thickness from 20 inches at the bottom to 12 inches at the top. Each stone is of the same width as the thickness of the walls, having pitched faces inside and outside. The basement is capped by a heavy course of freestone water table, which presents a massiveness in harmony with the foundation and superstructure.

The superstructure is built of hard red bricks and freestone trimmings, laid in cement mortar. The walls are 27 inches thick at the pilasters, and 22 inches thick at the panels. The exterior face of the walls is built of repressed stock bricks, laid in mortar of the same color, and the windows and doors are capped with projecting brick arches. Brick piers 3 feet square are built in the basement, upon which rest one end of double 10-inch cross beams which support the 6-inch longitudinal beams and cast iron plates of the working floor; and also the cast iron columns which support the main roof, one side of the coal bins, and the roof over the same.

The main roof trusses are of the "Fink" pattern, and constructed of angles and plate steel. The purlins are angle steel, and are secured by bolts through elongated holes to angle knees riveted to the trusses. The roofs are covered with heavy black slate secured to the purlins by copper hooks. The whole roof is surmounted by a lantern running the full length of the building. On each side of the lantern there is a row of pivoted windows, through which the retort house is ventilated and the upper part lighted. The sashes are cast iron, and the glass with which they are glazed is fastened by steel pins.

The towers inclosing the water tanks have dormer windows on all

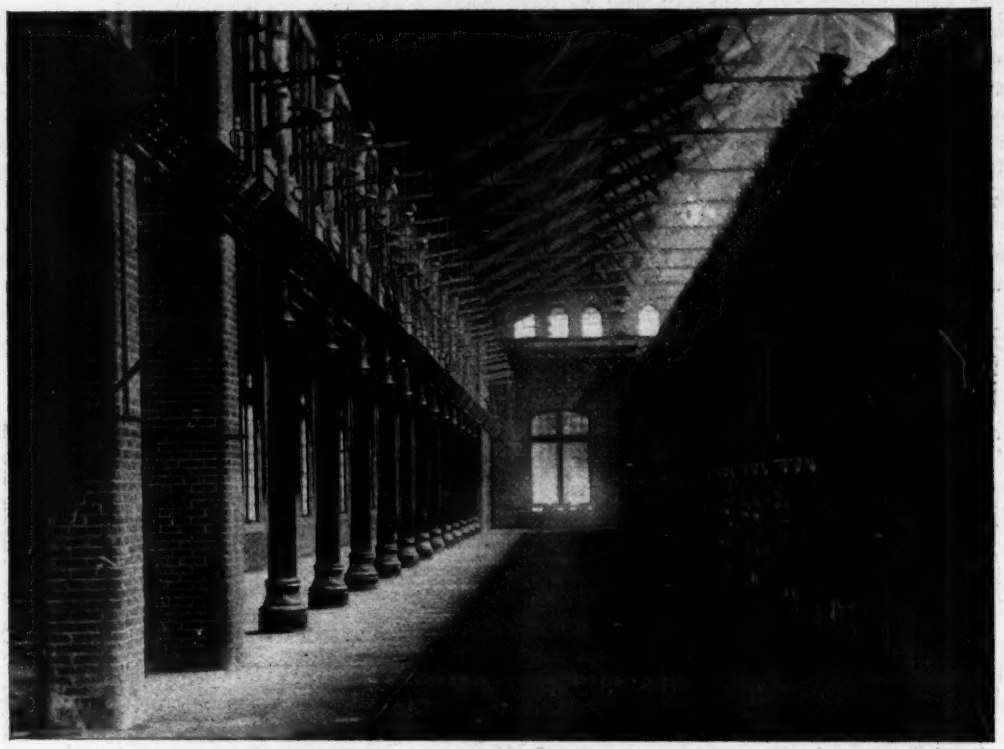

**Fig. H.**—Interior View of Retort House, Looking South from the Center.

**Fig. I.**—Coal Gallery.

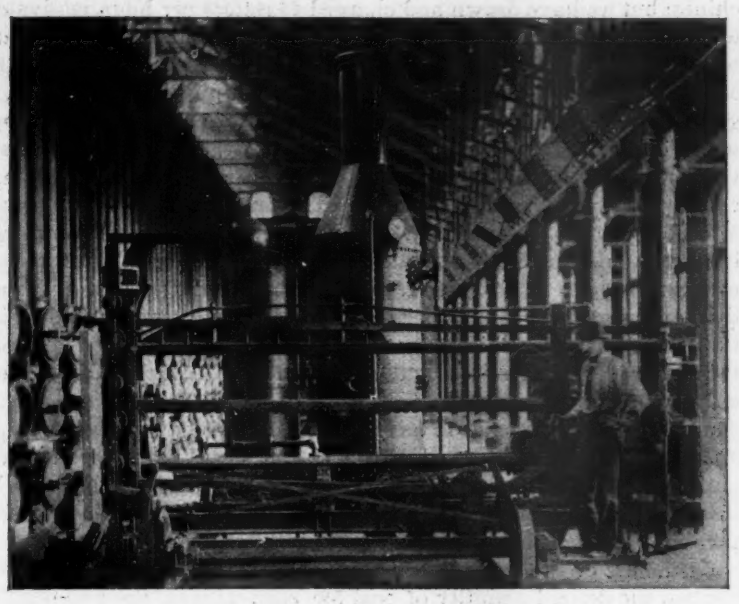

**Fig. J.**—Ross Discharging Machine.

sides, and they add much to the good appearance of the building. The gutters are all cast iron, and those on the sides of the building and towers form the cornice.

The coal bins have a capacity for 1,000 tons, being sufficient for more than two days' supply when working the retort house to its maximum capacity.

The bottoms of the coal bins are constructed of cast iron flanged plates bolted together. The flangers are planed to secure tight joints, thereby preventing the sifting of coal dust upon the floor below them. The inclination of the bottom is 41½° with the horizontal. The plates rest upon 6-inch I beams, supported at one end by the side walls of the building, and the other end framed into eight (8) inch I beams, fitted between the cast iron columns. The fronts of the bins are constructed of steel plates riveted to tee-iron studding. Directly opposite the side retorts of each bench there is coal chute and gate attached to the front of the bins, from which the hopper of charging machine can be filled with coal. By providing ample storage in bins sufficient coal can be elevated in the day time to run over nights and Sundays if desired, and the coal can be elevated more economically than if it were necessary to elevate daily throughout the 24 hours. The coal is delivered at the works landing in barges containing 500 tons; it is shoveled from the barge into cars that contain two tons each, and, when filled, they are hooked to a cable and elevated up an incline, the top of which is upon a level with the retort house coal bins. The cars on entering the engine room at top of incline are unhooked automatically and given sufficient momentum by the engines to send them into the retort house; thus saving time and labor that would be involved if the cars were stopped and pushed in by the men employed to dump them. The height of the lift varies with the stage of the river—from 95 feet at times of low water to 35 feet during high water. The capacity of the elevator is 60 tons per hour, and the cost of elevating from barges into retorthouse coal bins, or into coal yards, about 20 cents per ton.

The cars used have hinged bottoms, and they are discharged by disengaging a pawl from a ratchet, fixed to a central shaft, from which chains connecting with car bottoms are unwound.

When coal barges cannot be received at works landing recourse will then be had to the coal stored in the yards, which will be elevated to level of coal bins, a distance of 40 feet, by hydraulic lifts, operated by steam pumps, equipped with automatic steam pressure regulators for maintaining uniform water pressure. By this system 40 tons of coal can be elevated per hour, upon two hoists working side by side, and the coal carbonized in 24 hours can be always elevated in the day time.

The bench arches are segmental, constructed with blocks 13 inches in depth, over the top of which hollow tile arches are built, with an intervening space of 3 inches between them. The arches are built to within 10 inches of the face of pier walls, and cast iron lintels are used to square up the fronts of the benches. Between the haunches of the arches, and up to the level of the lintels, firebricks are used for filling, on top of which five courses of red brick are laid dry, and one inch apart, between the face walls; the last five courses are imbedded in mortar.

The exit flues from the benches are 5 feet below the floor line, and are built in the back walls. The flues are built plumb up to the floor line, where auxiliary openings have been left in them. These are covered by tiles which can be reached from the fronts of the benches, and will be removed before the lower exit flues become submerged in times of floods. Above the floor line the flues are inclined toward the centers of the benches, and at the top of the stack those of every two benches on opposite sides are built together as one chimney. The walls of the chimneys are 9 inches in thickness, and they are securely bound together by tie-rods connecting cast iron angles. The chimneys are 6 feet in height above the stack and 4 feet apart, thus leaving a passageway from one side of the stack to the other. The benches are constructed on the regenerative principle, but owing to the flood contingency the waste heat flues from the benches were not carried down low enough to heat the primary air supply. The secondary air is heated by passing through horizontal flues below the floor line. The furnaces are 10 feet in depth and are 4 feet 6 inches in length by 2 feet 6 inches in width at 1 foot above grate bars.

The ashpans and grates are 2 feet in width, in front of which there are large furnace doors and frames, having planed surfaces and fitted with cotter bars and screws. The back walls of the furnaces are built plumb 15 inches above the grate bars, and then offset 6 inches; then 2 feet plumb, and again offset 6 inches; then they are racked back to the rear wall of benches. On the first offset a set of temporary bars can be rested, which will be forced through the coke just prior to the time of clinkering to support it while the ashes and clinkers are being removed from the bottom of the furnace. On the second offset will rest the grate bars in times of high water, as experienced in 1884; opposite which auxiliary furnace doors and frames have been built in the front walls of the furnaces, and the openings in the frames have been built up with bricks, which can be removed should the necessity arise. The furnaces are charged through cast iron chutes lined with firebrick, the tops of which are level with the floor, and covered with hinged lids. The furnace chutes are constructed so as to slide as the brickwork of the benches expands.

In the pier walls of the benches cast iron boxes are built, into which the double 10-inch I-beams (that support the floor) extend, and rest upon a train of cast iron rollers. When benches are fired up the beams will not be strained as the brickwork expands (which would happen if they were built in brickwork), but will roll a little further back into the cast iron box. The floor plates in the fronts of the benches have been constructed in detail to provide for this same expansion.

The floor beams, carrying the cast iron floor plates of the operating floor, are separated one-quarter of an inch at the ends and are fastened together by fishplates and bolts, the bolt holes being elongated to allow for expansion and contraction.

The retorts are oval shaped, and are set in three tiers with their centers in vertical and horizontal lines, thus enabling the machines to draw or charge three retorts while in one position. The horizontal distance between retorts is 5 inches, and the vertical distance is 3 inches.

The mouthpieces are fitted with self-sealing lids, cotter bars and screws, and are secured to retorts by tee-head bolts. Supplementary to the bolts three 4x4 tee-bars are placed horizontally against the flanges of mouthpieces, and are secured by angles and bolts to the 8-inch I-beam buckstays of pier walls.

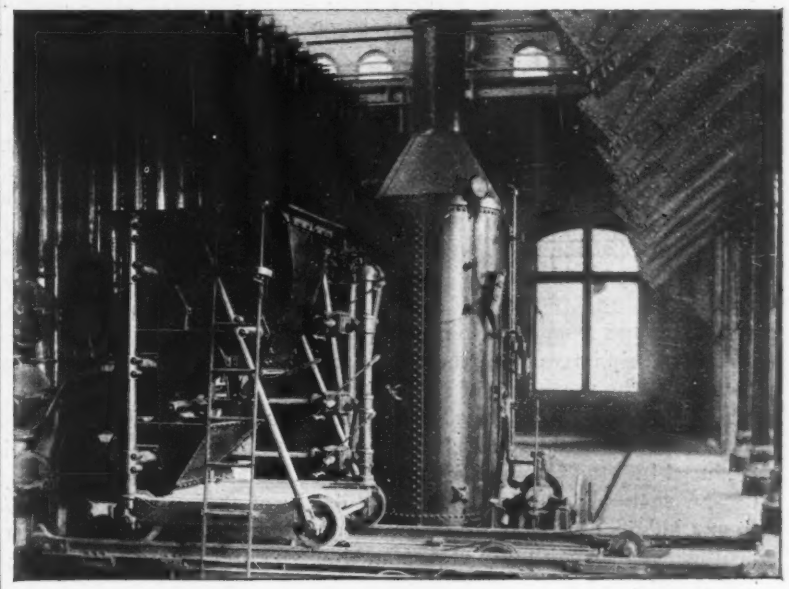

**Fig. K.**—Ross Charging Machine.

The standpipes are 6-inch cast iron flange and spigot pipes. The flanges are faced to insure tight joints when bolted to the bridge pipes. The dip pipes and bridge pipes also have faced flanges. Each bridge pipe is provided with cover lids, fitted with cotter bars, hinge pins and screws. One lid affords access to the cross pipe and dip and the other to the standpipe.

The hydraulic main is of combination steel and cast iron construction, 24 inches in width and depth, and equipped with a diaphragm and cleaning pocket running the full length of each section. The bottom is so shaped that the lowest part is directly under the diaphragm to facilitate the removal of any heavy deposit that may accumulate from time to time. One side of each of the hand holes on the top of the cleaning pocket is flush with the curved bottom plate of the hydraulic main; and when heavy tar has been deposited therein an ordinary scraper can be used to advantage to remove it. There are 6 sections of hydraulic main upon each range of 13 benches. Five of the sections serve two benches each, and one three benches. The top plate projects 1 foot over the back of the main, being supported by brackets, thus forming a walk, and also a cover to prevent the accumulation of dirt upon the clean-out pocket. The hydraulic main is supported by cast iron stands resting upon horizontal I-beams that connect the tops of the pier wall buckstays on opposite sides of the stack of benches. These beams project 1 foot beyond the buckstays, and when necessary to level up the hydraulic main, it can be done very easily by the use of a jack-screw and strut from the retort house floor; and, as the take-off pipes, tar pipes and bridge pipes are all supported by the same I-beam, all will be raised together without any connections being strained.

A double seal valve is attached to each section of the hydraulic main and its overflow connected with the main tar pipes. It consists of two valves, each within a separate compartment, and having united and independent adjusting stems. One of the valves will be adjusted to allow part of the tar made to flow continuously from the bottom of the hydraulic; the other one to maintain the seal on the dip pipes at proper level by allowing the excess of liquor to overflow.

On each side of the stack of benches a gas main is suspended from horizontal cross beams, supported by uprights resting upon I-beams mentioned above. Each section of the hydraulic is connected with the gas main by an 8-inch pipe and valve. The gas main increases in diameter from 10 inches at the north and south ends of both stacks, to 12 inches, to 14 inches, and to 16 inches at the center of the house. The four gas mains are connected by 16-inch valves to the 24-inch pipe running east and west, beneath the bridge supporting the trackways. The route of the gas is from the retort to hydraulic main, to take-off, to gas main, to the center of the house; thence east or west, or in both directions, to sides of building; thence south under coal bins to end of building; then down and into the air condensers in the basement. The air condensers are located between the basement side walls, and the piers supporting the coal bins and main roof. They consist of cast iron rectangular boxes, having a 24-inch flanged pipe connection on one side, and 11 hubs for 10-inch standard gas pipes on the other. The hub sides of the boxes are set facing each other at north and south ends, and on both sides of building, and are connected together by 11 lines of 10-inch pipe, having a total gradient of 2 feet. When the retort house is working up to its maximum capacity, the condensing pipes therein will have 7 square feet of surface to cool 1,000 cubic feet of gas per minute.

The tar pipes from hydraulic main connect with seal boxes set just below the floor at the south end of the benches. Overflowing therefrom it runs east or west, or in both directions, to the south end of the air condensers; it then flows along with the gas through the bottom tier of pipes. From the outlet of the air condensers, on each side of the basement, the gas and tar flow through a 24-inch pipe (underground) to the center of the north end of the building, where the two lines are connected by a 30-inch tee. Each of the two tar pipes from the hydraulic, upon the north half of the benches, connects with the 24-inch gas main, and from that point all of the tar flows with the gas produced, to drip boxes near the inlets to the multitubular condensers, located on the north side of Front street.

Three of each of the Ross steam charging and discharging machines have been installed in No. 5 house. This type of machine was first introduced into the Cincinnati works in 1879. Since that time so many improvements have been made in the details of their construction that in our judgment retorts can be drawn and charged with them more expeditiously than with any other machine, and at less expense for labor and repairs.

It is true that we have had no experience with any but the Ross machines; but we have drawn and charged 45 retorts per hour, equivalent to 1,080 retorts per day, with one pair of machines, two engineers and one assistant (to fill the coal hopper upon the charger), which is, so far as we know, in excess of the rated capacity of any other machine, as given by the patentee, manufacturer or engineer using them. The actual time required per draw from time of slacking off first retort, until the last lid is closed, divided by the number of retorts drawn and charged, will not exceed 50 seconds. The drawing machine has given almost perfect satisfaction for 15 years, during which time a number of improvements have been made in various details. The improved charger has been in use since 1888, and its simplicity both in construction and operation commends its use. As to the evenness with which the coal is thereby laid in the retorts, it is, of course, dependent upon the skill and care exercised by the engineer. The charges are laid evenly throughout the length of the retorts; however, to insure such a condition it is the practice to have a long rake passed over each charge, and which is also used to push back any coal left in mouthpieces before closing the retort lids. This operation is quickly performed by the lid men working in pairs, one man using the rake and the other closing the lids.

By the use of the charger, after the hoppers have been adjusted to contain the desired quantity of coal for each charge, the weighing of coal can be dispensed with, and thus effect a saving equivalent to the cost of repairs upon both machines.

At the East End Station there has not been a pound of coal weighed in eight years, and yet, at the end of each year, the discrepancy between the measured stock of coal in the yards, and that as shown by books, is always less than at the West Station, where every pound of coal carbonized is run over a scale, and apparently, accurately weighed; and the yearly make at the latter works is only one-half of that of the former.

The method of estimating the coal carbonized is as follows: Prior to the delivery of coal barges at the works landing, they are measured by an officer appointed by the Cincinnati Chamber of Commerce. From the measurements taken of the length, breadth and depth of barges, the contents in bushels of 2,688 cubic inches are calculated. When unloading the barges, a record is kept of the total number of car loads elevated from each one, and the average contents of each car is obtained by dividing the number of bushels as shown by the gauger's certificate, by the number of car loads elevated. A record is also kept of the number of car loads dumped daily into the retort house coal bins, and also into the coal yards. The contents of each car load being known, also the weight of the coal per bushel, the number of tons dumped into retort house bins can be easily calculated. The stock of coal in the bins is checked every ten days with the balance that should be in them as shown by the books; and if we find that the stock in the bins is in excess of that shown by the books for the following ten days, the weight of each charge of coal per retort will be reduced 1 per cent. If there is a shortage in the stock in bins, then, for ten days thereafter, 1 per cent. will be added to the estimated weight of each charge per retort, and so on. By this system a balance is forced, and the coal account is kept practically correct.

Having read his paper, Mr. Miller called the attention of the members to a set of photographs, taken at short intervals during the construction of the retort house described, which were ready for the inspection of anyone who wished to look at them.

### *Discussion.*

Mr. Littlehales thought Mr. Miller's Company had put itself in an excellent position when it built a carbonizing plant that could be depended upon to turn out 50,000 cubic feet per man per diem. It looked to him, though, that the cost of elevating the coal for storage (20 cents per ton) was rather high. Another point was that such construction might not be economical, relatively, in small works; for what would be good practice in a plant carbonizing 100,000 tons of coal per annum might not be equally good where the coal coked was, say, 10,000 tons. There was such a thing as putting too much machinery in a small works.

Mr. Butterworth also thought that the cost of lifting coal to store it was rather high in Cincinnati. They were very unfavorably situated in Columbus, in that their works were three-fourths of a mile from the railroad, and the coal had to be hauled in wagons to the storage sheds. Despite that, however, the cost is but 15 cents per ton. He would like to know what, in Mr. Miller's opinion, would be the smallest sized works in which stoking machinery could be profitably employed. He (Mr. Butterworth) then referred to two different styles of retort house roofs that they had at Columbus, and he thought if he were to build a

new house he would seriously consider the covering of the same with a board roof finished in tar and gravel. They had too much trouble with slates blowing off during wind storms, etc. Mr. Miller's arrangement of I-beams for floor support pleased him very much.

Messrs. Littlehales, Cowdery, Harbison and Ringwood then took up the discussion, many points of interest being brought out. Figures and mechanical details, however, abounded so much in the speeches that no long hand transcription could do it justice. The same remark applies to Mr. Miller's replies to the questions, although we may say that he explained that the cost of storing the coal in Cincinnati came from the fact that it had to be elevated 95 feet.

On motion of Mr. Neal a very hearty vote of thanks was extended to Mr. Miller for the exceedingly interesting paper read by him.

(To be Concluded.)

## Combustion in Gas Engines.

The *Gas World* notes that Messrs. F. Haber and A. Weber have executed a long series of experiments on the above subject, recorded at length in the *Journal fur Gasbeleuchtung*. The following are their principal conclusions: Carbonic oxide, hydrogen and marsh gas might escape with the products of combustion in a gas engine, even so that the discharged products are still combustible; and then the temperature of the cooling water is not a high one. The composition of the waste gases, as well as the phenomena observed are not the same as when a flame is cooled by being chilled against a cool surface, before the necessary oxygen has time to combine with it. In a gas engine cylinder the explosion is so rapid that chilling by the walls can hardly affect the combination in the interior of the mass of gas; the temperature throughout the mass of gas is pretty uniformly the same throughout, on account of the vibratory mixing of different currents within the cylinder. The imperfection of the combustion is more probably due to dilution of the charge, for this results in a lower temperature of explosion, and the slow-traveling flame produced does not sufficiently heat up any part of the gas. This would not explain imperfection of combustion in a gas engine if the mixture were uniform throughout, for a mixture which, as a whole, produced this effect, would be useless in a gas engine, being too slow in its action.

The explosion of a useful gas mixture is smart, like the crack of a whip. In a gas engine, however, the mixture is not uniform, but is partly inexplosive and partly feebly explosive; and it is in these parts of the mixture that the unburned or incompletely burned components of the waste gases take their origin. These parts of the mixture are found in the neighborhood of the piston; as the piston travels it takes first the waste gases after it, and then these are followed by air, and lastly by a mixture of gas and air. These three layers become blurred upon compression of the mixture, but not sufficiently so to prevent the explosion, which at first is sharp and distinct, from becoming retarded, traveling more and more slowly, and then dying away within the cylinder. The weaker the mixture the larger the space near the piston which is occupied by the retarding mass of gas, and the further away from the piston does the explosion cease to be sharp and distinct. Besides this, hydrogen and marsh gas may readily get into this inert layer by diffusion; but it is not easy to attribute the presence of carbonic oxide to this cause. With valves, then, the imperfection of combustion is due to weakness of the charges. With slides, however, it is not so easy to account for it. There is a difference in the kind of explosions produced which itself runs in cycles; there is an alternation of sharp and dull explosions which respectively are, in a 16-time cycle, the first and the second after two movements without explosion; but in all cases the production of smoke and unburned gases is connected with feeble explosions.

## The Conversion of Culm into Gas.

[From a paper by Mr. N. W. Perry, before the Anthracite Coal Operators' Association.]

The problem of preventing the waste of the product of your mines is one that you have labored with for years, and how well you have solved it is shown from the fact that whereas in one district (the Panther Creek basin), from the commencement of mining in 1820 to 1883, it was estimated by Mr. Ashburner that 20 per cent. more of the coal mined had gone to the dirt bank than had been marketed during the two years, 1881 to 1883, the amount of coal going to the dirt bank was but 52 per cent., and at the present time conservative statisticians figure that 20 per cent. is a fair figure for the culm bank waste in the anthracite regions.

The Pennsylvania Coal Waste Commission estimated that from the commencement of mining up to 1892, the coal and dirt sent to the culm bank averaged about 35 per cent. of the total production, or about 315,700,000 tons. To this is being added about 20 per cent. of a largely increased annual yield—a drain upon your resources and an item of large expense. This annual flow of fuel, amounting to more than 100,000-horse power each year, for which the more marketable article has already paid tribute—is at present a cumberer of the ground, and for this reason an additional tax upon your resources.

The most significant indication of the progress of engineering science is the rapid increase in directions in which hitherto waste products are being turned to account, and it is to one of these directions that I would direct your attention this afternoon.

In the history of our early gold and silver mining we find the counterpart of the culm banks of to-day. Material thrown away then produced fortunes for those who came after, and the tailings from the gold and silver mines were made to yield their precious metals at a profit. So we, to-day, are casting about to find some means for forcing the culm piles to yield in an available form their still more precious burden, the energy of the sun stored up by nature.

I had occasion some time since to make a study of the economic conditions of the city of Scranton, with a view to determining to what extent it could offer advantages for the location of manufacturing concerns such as the projectors of the Niagara Falls power project were hoping to attract to their neighborhood.

This led to a comparison of the cost to generate power in the two localities, because the advantages which each possessed would depend upon the cheapness with which it could produce power locally. Whatever means was accessible to the one for the transmission of power was equally accessible to the other, so that granting that the cost to produce it locally was the same in both, each could transmit it to the same distance at the same expense.

My calculations of the cost of generating power at Scranton were based largely upon the data obtained by a committee from the Scranton Engineers' Club from tests made under working conditions in two of the largest establishments in the city—viz., the works of the Lackawanna Iron and Steel Company and the Dickson Manufacturing Company. Many of the items, however, I had to supply myself—among them the cost of the fuel delivered at the boiler. While I knew that culm could be had in almost unlimited quantities at the bank for from 10 to 20 cents per ton, I assumed it to cost delivered at the boiler 46 cents and that "birdseye" would cost 50 cents.

I found that power could be generated for 365 days of 24 hours each at a cost of about $25 per horse power, or for 365 days of 10 hours each for about $15.50, and for 313 days of 10 hours each for about $13 per horse power, including all fixed charges, such as interest on the investment at 6 per cent., inspection 2½ per cent., loss of interest during construction 6 per cent., insurance, taxes and renewals 5 per cent., and interest on investment 6 per cent.

For Niagara the basis of calculation was the price of $20 per horse power in 1,000-horse power lots delivered on the premises of a customer nearby. These are the best terms yet offered at Niagara, and mean 24-hour power 365 days in the year at $20 per horse power, whether utilized or not.

Making the same charges for interest, depreciation, taxes, etc., of the customer's plant, together with charges for losses in transformation and interest, etc., on the transformers, the figure reached was $27.26 per horse power per year.

The Niagara customer, however, being compelled to pay for his power the same price whether he used it all the time to the minute or only a portion of the time would be placed at a disadvantage with the Scranton manufacturer, for the $27.26 when divided among the lesser hours used became a far larger charge per horse power hour than the Scranton power, generated and paid for only when needed. Thus the Niagara customer who used his power but 10 hours a day would be paying 50 per cent. more per horse power hour than would the Scranton manufacturer who generated his power by steam from culm costing 50 cents per ton delivered.

Burning coal under boilers is, however, not the most economical method of generating power. Taking coal as the starting point, the maximum theoretical efficiency of the steam engine is 30 per cent., while the maximum theoretical efficiency of the gas engine is 80 per cent. All mechanical devices fall short of theoretical possibilities, and while the steam engine, through the intermediary of the boiler, might possibly give us 30 per cent. of the primal energy of our fuel, and the gas engine 80 per cent., neither of them under the most favorable conditions approaches these figures. The best that we can do under com-

mercial conditions is to obtain in useful form through the steam engine about 10 per cent., and through the gas engine about 20 per cent. of the energy of the coal, although under test conditions both of these figures are exceeded. This has led a distinguished English engineer to say that the attained efficiency of the gas engine is equal to the theoretical efficiency of the steam engine.

If, therefore, we should convert our culm into gas at the culm pile and utilize it in gas engines in the power station we would get a somewhat lower figure for power by reason of the better utilization of our fuel, but there would be other economies far more important than this.

One of the greatest difficulties experienced in the utilization of culm as fuel has been to find a grate upon which it could be burned without too much loss. While this has been measurably obtained in the McClave and other grates, if the culm is not carefully sized the loss in unconsumed carbon going into the ash pile is still large.

As an example of the Lackawanna Iron and Steel Works where the fuel is unsized, as much as 30 per cent. of the unconsumed carbon is sometimes found in the ash pit. The stoking with culm is more laborious and costs more and since culm is an inferior fuel the boiler capacity per unit output must be increased about 15 per cent., which means increased fixed charges.

Gaseous fuel can be transmitted short distances far more cheaply than can the solid fuel or the resulting power, so that in the estimate of the cost of power at Scranton, if I had assumed the conversion of the culm into gas at the culm pile and its transmission in pipes to the power station, the transportation costs, stoking, and removal of ashes would have been lessened considerably.

As illustrating the cheapness of gaseous transmission of energy, calculation shows that assuming a gas having a specific gravity of 0.55 and a calorific power such that 25 cubic feet burned in a gas engine will give a horse power for one hour, 1,600 horse power can be delivered at a distance of 3 miles with a loss of but 0.07 per cent. of the energy transmitted.

The cost of the pipe (without laying) for such transmission, I figure at $16,000, estimating cast iron pipe at $20 per ton. To transmit this same amount of energy electrically to the same distance, with the same efficiency, using 10,000 volts, would require 538,000 pounds of copper, which at the very low price of 12 cents per pound would cost $64,562, or four times the cost of the gas mains.

But after all, none of the above items are so controlling in the cost of power production as the load factor, which is the proportion utilized of the total capacity of the plant.

In our most favorably situated electric light and power stations, the maximum demands on the station are seldom less than 2½ times the mean demand. This means that, to supply their customers, there must be supplied 2½ times as much machinery—machinery, boilers, engines, dynamos, etc.—as would give the same aggregate output if worked continuously at their rated capacity. It means larger fixed charges as well as greatly increased operating expense per unit of output. It also means that some of the machinery is lying idle a portion of the time, or at best operating at partial load, and therefore uneconomically. The boiler plant alone is a great expense under such conditions, for it has been estimated by competent authority that on loads similar to those of an electric lighting plant the consumption of coal by the boilers, while banked, amounts to 10 per cent. of the total consumption of the station.

With gaseous fuel most of these inefficiencies are removed. We have a most efficient method of storage in our gas tank, which enables us to operate our gas generators continuously at their best output, and with our gas engine no power is wasted in getting into running order nor in shutting down. At the turn of a valve the power is on or off as required, and hence, with a mimimum investment, maximum results are obtained.

But the market which you are seeking is far larger than that afforded by the nearest city to your culm pile. I have given the above data simply to show that by converting culm into gas at the culm pile, and thence transmitting it through pipes to the neighboring city or town, you can there produce a horse power more cheaply than yet obtainable at Niagara Falls. This being the case, the anthracite coal regions have a territory which they can supply, quite as large as that tributary to Niagara, with at least equal, and I think better, facilities for reaching that territory.

It now remains to see how that territory can best be reached.

It costs, I believe, about 1 cent per ton mile to transmit coal on the railroad. This is the cheapest form of transmission of energy for long distances thus far devised, but it costs 45 to 50 cents a ton to large consumers in New York and Philadelphia to deliver this coal from the water front to the sidewalk in front of the boiler house. This charge being the same for the low grade as for the high grade fuel, and forming a large proportion of the cost of the fuel to the consumer, the better grades are, of course, the most in demand. The culm being a low grade fuel, will not, therefore, stand long transportation charges so well as the better grades, and is cut off from these markets.

[To be Concluded.]

## SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, November 10th, 1896.

*A Feature of Municipal Management.—A Mishap with an Hydraulic Main.—Troubles with the Electric Light.—An Explosion of Acetylene.*

Advocates of municipal ownership of gas works and other trading concerns would do well to read, mark and inwardly digest, a series of articles entitled "An Elective Auditor's Notes," which are now appearing in the Manchester *Daily News*. The author is Mr. S. Norbury Williams, one of the gentlemen entrusted with the responsibility of examining the municipal accounts, and amongst other things he gives some particulars of the expenses incurred by the committee who manage the affairs of the gas undertaking, which is the property of the ratepayers. A sum of £362 appears to have been spent on the personal comforts of the committee during the year, the chief item being a matter of £52 or so for hotel and travelling expenses in connection with a day's trip to inspect the gas and electric light works at Leicester; then there was £16 for a tea on the occasion of the annual inspection, and £20 for a similar entertainment when opening some new show rooms. It is also hinted that something was spent in entertaining the Local District Institution of Gas Engineers on the occasion of their visit to one of the gas works belonging to the Corporation. And the committee are further charged with consuming quantities of spirits, wines of the finest vintages, and choice cigars, all provided at the expense of the ratepayers.

The first thing that strikes one about this matter is the smallness of it. £362 would be a large sum to expend amongst a committee of two or three members in a small town, but in the case of Manchester, with several different "stations," a gas rental approaching half-a-million sterling, and a large committee of nearly 30 members, no reasonable person can find anything to complain of. We have simply an illustration of one of the temptations to which the managing committees of municipal trading departments are exposed. From what one hears of committees visiting London, Edinburgh, Paris, etc., it is not unlikely that in some towns the investigations of a Mr. Norbury Williams would lead to more startling revelations, than that gentleman has been able to unearth for the information of the Manchester ratepayers. In fact, the Manchester Gas Committee have good reason to complain, if, after placing valuable time and ability at the disposal of the ratepayers, they are begrudged a glass of wine or a cigar, and to be ordered to carry their own luncheon or tea baskets on their rounds to the various committee rooms or gas works. Possibly Mr. Williams has in view the desirability of keeping a sharp eye on these little items, with a view to guard against the gradual creeping in of abuses in the course of time rather than the actual raising of objections, or finding fault with matters as they are. In the case of gas companies, it is now the usual plan to refuse altogether the admission of refreshments to the offices or board rooms, and, except on special occasions, the directors incur no personal expenses whatever on behalf of the company. But directors get their attendance fees, and the committee men get the honor of doing the public work *gratis*. Why a municipal body should expect to have its affairs managed for nothing, while it would be absurd for any individual to expect to get his little shop or office attended to on similar terms, is one of those things which "no fellah can understand."

An extraordinary mishap is reported from Stalybridge. For several hours the gas supplied to the inhabitants of that town was so highly charged with sulphurous fumes as to affect the public convenience and health, and operations had to be suspended in mills and other places. The cause of the trouble was found to rest with some new settings of regenerator furnaces. The hydraulics were fitted with sluice valves for running off the thick tar, and one of these was either leaky, or left open by accident or design, with the result that the dip pipes were unsealed, and large quantities of air were drawn in when the retorts were opened for drawing and charging. This seems to have gone on unnoticed for some time, as revivification *in situ* commenced with great energy in the oxide purifier boxes, generating sufficient heat to set the

free sulphur in the oxide on fire, while sufficient air was present to support combustion, with the result that large quantities of sulphurous acid passed into the gas, and the consumers received a mixture that was worse than plain unpurified gas. The hydraulic main has been the cause of some few accidents, not many, but in other cases the damage has been confined to the retort house, and taken the form of the passage of gas back through the ascension pipes into unused settings. I have never heard of such a result as firing the purifiers obtaining before. The accident reminds us of the importance attaching to the arrangements for drawing off the tar from the hydraulic mains, and of the necessity for using thoroughly well-made and efficient appliances for this purpose.

The electric light has been somewhat troublesome lately. At a church in London, on Sunday week, the light completely failed "immediately after the collection," leaving the building in complete darkness. The officiating minister was fortunately able to calm the congregation and prevent a panic. After endeavoring to bring the electric light into action, but without success, a few gas jets that had been retained in the edifice were lighted, and the service was concluded. A more serious failure occurred in the city last week. For three-quarters of an hour the current was entirely stopped over a large and important area, just at the busiest time of the evening. A hasty rush was made for gas, candles, etc., and many jewellers and others holding valuable commodities of a portable nature made haste to lock, bolt and bar their premises, in view of energetic action on the part of those who love darkness rather than light. This accident induced the remark in a morning paper that "the failure was not of that temporary nature for which the electric light is notorious." Within a few days of this event the switchboard at a London theater burst into flames, setting the scenery on fire, and necessitating a stoppage of the performance. The firemen were fortunately able to subdue the outbreak without the fact coming to the knowledge of the audience, and after some delay order was restored and the entertainment was continued. These mishaps form a striking comment on the action of the committee of fire insurance offices in London, who have just announced that the rates for insurance of electric light stations would be increased to 10s. 6d. per cent. per annum, subject to a special clause relieving the office from any loss due to self-ignition of the dynamos. If this stipulation is excepted, the rate will be 21s. Much outcry and indignation from owners and managers of electric light companies have been the result, but this does not alter the fact that the committee know what they are about, and that their decision is not the result of opinion or prejudice, but is based upon hard facts. Some years ago the insurance offices did not care to accept gas works under about 5s. per cent. Then it was said that an insurance could be had for 3s. 6d. per cent. And now policies including risk of explosion can be obtained from any reputable office at about 2s. 6d. These are all based upon the results of actual working. When the supply of electricity commenced a great deal was said about the "safety" of the new agent, and perhaps that is why the fire insurance offices took it at what is known as the second class rate, adopted for ordinary business premises, of 2s. 6d. per cent. per annum. It was soon found that this would not do, and the rate was doubled. And now, after a few years' further experience, the electric light station is classified as among the "hazardous" risks, such as theaters or firework manufactories. Some attempt is made, of course, to weaken this action by means of ridicule. It has been suggested that a Mutual Insurance Association should be formed amongst electric light companies, and others propose forming a reserve fund and becoming their own insurers. After all this splutter, they will probably find that the best plan is to accept the unavoidable, and pay down the 21s. per cent. with a good grace. Whether they do this or not it will now be absurd to talk about the superior safety of electricity as compared with gas.

Another modern agent has also been causing trouble. A steel cylinder charged with compressed acetylene gas, or, as some say, with liquefied acetylene, has exploded, wrecking the whole frontage of a building, breaking the windows in the neighborhood, killing two workmen and injuring a third. Acetylene has already acquired for itself a somewhat uncertain character, especially when it is compressed or liquefied, and the accident in question is by no means reassuring. It occurred in a populous suburb of Paris, where a factory has been established for the preparation of acetylene and for charging steel cylinders under pressure, to be delivered to users at a distance. During the dinner hour, two workmen were engaged in examining tubes that had been returned for refilling, and the only other person present on the premises was a stoker who was about to resume work. One of the tubes exploded, with the unfortunate results above referred to, and there is no direct evidence to show the cause, but it is stated that the workmen either held it near a lamp, or else unscrewed the stopper with such force as to generate heat. The two men who alone could have stated the origin of the disaster, were killed at once, being terribly burned and mutilated, and the stoker, though covered with fragments of woodwork, etc., was found to be only slightly injured. The tube that failed was stated to be one of a parcel of 75 empties that had been returned from Brussels, though it must have been practically full.

All these effects were brought about by one tube only, but it is evident that there was a narrow escape from a terrible catastrophe, as there were on the premises 30 tubes, each containing 26 gallons of liquid acetylene, and also two large reservoirs, one of which contained 500 gallons, but the force of the explosion went in another direction. The direction taken by the force of an explosion cannot be accurately set out beforehand, and one cannot help wondering what the consequences would have been if it had happened to strike across the 500-gallon tank, or the 30 tubes with their aggregate content of 780 gallons. Things are looked after very sharply in Paris, but there is evidently room for improvement in regulations which admit of a substance like liquid acetylene being stored to the extent of 2,000 gallons or so in a populous locality. Most of us are acquainted with the popular method of locating a gas escape with the aid of a lighted candle; but it is scarcely probable that the acetylene cylinders were examined by similar means, or that a workman, presumably having some knowledge of the properties of the material he was dealing with, would be so stupidly foolhardy as to bring the cylinder near a light. No doubt an official inquiry will be held, at which all available evidence as to the cause of the explosion will be brought forward. Meanwhile, there are two conjectures that may be advanced as to the cause of the explosion. The first is, that the contents of the ill-fated tube must have been, as it were, trembling in the balance between the liquid and the gaseous condition, requiring only a very slight disturbing cause, such as a sudden jar or shock, to determine the course of action. And the second, that one of the percussive compounds, such as acetylide of copper, had formed in small quantity on the screw of the stopper, and was fired by the friction generated in unscrewing. The first appears the more likely, because the second necessitates the presence of an explosive mixture of acetylene and air in the cylinder; and the disastrous results appear to be more widespread and powerful than might be expected from the mere firing of the contents of a small cylinder.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At an adjourned meeting of the Board of Directors of the Brooklyn (N. Y.) Union Gas Company the following executive organization was perfected: President, James Jourdan; Vice-President, H. H. Rogers; Secretary, Edwin Ludlam; Treasurer, E. R. Chapman. A semi-annual dividend of 3 per cent. out of the earnings for the last six months was declared, payable December 1st.

The Long Island Gas and Fuel Company was incorporated on the 21st inst., by Messrs. W. B. Burnet, W. S. Chapman, A. M. Davis, J. C. Ritchie and J. A. Simmons, of New York; N. G. Read, of Boston; and W. M. Chapman, of Brooklyn. The nominal capital is put at $100,000. and the purpose as stated is to manufacture and supply gas for fuel in Brooklyn, N. Y.

The Board of Public Works, of Detroit, Mich., have demanded the resignation of the official gas inspector of the city—Mr. Krecke. The understanding is that Mr. F. G. Brainard is to be appointed, and that he will assume the duties of the position on December 1st. The salary is $1,500 per annum, and the reason given for exacting Mr. Krecke's resignation is that he has held the place for a sufficient length of time—there is not even a hint of his inefficiency.

Later information respecting the above news is to the effect that Mr. Brainard, who is a resident of Flint, Mich., declined to accept the inspectorship, and the Board thereupon appointed Mr. Willis P. Rand to the place. Mr. Rand is a resident of Detroit. He is an engineer and machinist.

A correspondent forwards the follows: "There were no remonstrants to the granting of the Jamaica Plain (Mass.) Gas Light Company's petition to the Board of Gas and Electric Light Commissioners for approval of an issue of new capital stock, of the par value of $100,000, for the purpose of paying the indebtedness and extending the plant, which petition was heard at the office of the Commissioners, on the morning of November 20th. Mr. E. M. Foss, President of the Company, appeared for the petitioners, and stated the purpose of the re-

quest. The present capital of the Company, he said, is $250,000, and the last increase of stock was made in 1892. The money to be raised was primarily for the payment of the outstanding notes of the Company, which amount to $6,500, which notes were given some years ago to meet improvements and extensions of the works, and are now falling due. One of the improvements contemplated by the Company is the enlargement of its purifying houses, and the additional purifying facilities will necessarily oblige the Company to change many of its pipes from 12-inch to 16-inch. To do this it will be necessary to expend $15,500. The Company has outgrown its present registering or station meters, and $2,000 will be required to replace these. All the coal now used has to be carted to the works by teams, and it is proposed by the Railroad Company to build a spur which will obviate the teaming, but the Company will be obliged to construct new coal sheds, at an estimated cost of $5,000. A new oxide house and enlarged tar tank facilities will have to be built at an expense of $4,500. In the instance of main extensions and replacements, a large expenditure will be incurred, and the total sum required to discharge all its obligations and pay for the betterments on the scale proposed, the Company claims cannot fall short of $98,000. Mr. Foss failed to explain satisfactorily why the Company increased its dividends from 8 to 10 per cent. per annum, at a time when it was really running in debt, because he was not President when the increased dividend was originally ordered. There had been a few sales of stock, recently, in small lots at auction. This was less than a year ago, and the stock was purchased by persons interested in the Company. The prices have ranged from $105 to $120 per share. There had been no proposition to lease the works. The Board in taking the case under advisement, said the case presented some unusual features, and that it was possible some further examination of Mr. Foss would be required before a decision was arrived at."

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THE Capital City Gas Light Company, of Des Moines, Iowa, is extending its main system, the purpose of the proprietors being to put down 5 to 6 miles of pipe in hitherto undeveloped territory.

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THE City Electrician of Cincinnati, strange to say, recommends that the city parks be lighted with gas instead of electricity.

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THE Metric Metal Company, of Erie, Pa., has issued a catalogue descriptive of its meters for measuring illuminating and natural gas. It is a well-arranged handbook, and besides listing its wares and the prices thereof, it contains many tables of value to gas suppliers, notable among the statistics being those which refer to the distribution of natural gas.

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ANOTHER useful catalogue recently received by us came from the Mica Manufacturing Company, of New York. Proprietor O'Neill is to be congratulated over the common sense and effective way in which the Company's price schedules are given.

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THE semi-annual ball of the employees of the Columbus (Ohio) Gas Company, which was brought off in their hall on the property of the Company, on the evening of the 25th inst., was a well-attended, harmonious and enjoyable affair.

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MR. W. B. GARRETT has been appointed collector for the Nashville (Tenn.) Gas Light Company.

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FOR solid "brassiness" we submit the following resolutions, adopted some days ago by the Street Board of Hartford, Conn.:

"*Whereas*, The Hartford City Gas Light Company was compelled, through an accident occurring by a break in the main supply pipe on Wells street recently, to deprive all citizens of Hartford of a proper supply of gas by shutting off the gate at its works; and,

"*Whereas*, It was subsequently ascertained that said Company does not maintain separate shut-offs on the branches of its main pipes; therefore,

"*Resolved*, That the City Surveyor be and he is hereby instructed to inquire into the matter above referred to, and obtain expert opinions as to the necessity of placing gates at certain points of said gas mains belonging to the Company and report to the Board."

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THE Street Board of Hartford for some time has been seemingly acting from the point of belief that the Hartford City Gas Light Company has no right whatever in the streets, for the Company has been hampered in every possible way in its work of altering its main system to adapt the same to the needs of the gas consumers of the city. The changes that are being made in the mains involves enough of difficulty of the ordinary sort to keep an engineer busy to surmount the same; but when to such difficulty is added that which springs from harassing municipal interference, the wonder is that the work goes on at all. The proprietors of the Hartford Company, however, never were "easy marks" for official sharpshooters, since they know what their rights are, and, so knowing, oblige others to respect them, even if such insistence develops more or less friction. This mention leads to the further remark that when the changes in the Hartford Company's main system shall have been completed that corporation will be the possessor of as perfect a distributing plant as it was possible to devise.

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ADVICES from Bristol, R. I., are to the effect that no further attempts will be made this year by the Bristol County Gas and Electric Company to secure the consent of the Town Council to the laying of gas mains on the main road. Our informant further adds: "I have been informed on good authority that the Company has made the following offer to the Town Council, which offer, for some reason or another, was not made public: The Company agreed to reduce the gas rate to $2.50 per 1,000 cubic feet as soon as the Council gave permission to lay the pipes, and agreed further to reduce the rate to $2 as soon as the pipes were laid. This on the face of it looks like a good offer, and the Company does not feel that it can offer anything more satisfactory. For some reason the Council refused the proposition, and there the matter rests."

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THE new owners of the works at Mechanicsburg, Pa., have determined to put the plant in good shape. To do this will virtually mean rebuilding.

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CHIEF JUSTICE START has signed the writ of *quo warranto* asked by the State, through Attorney General Childs, to compel the Duluth (Minn.) Gas and Water Company to show cause why its franchise should not be declared forfeited. The writ, which is returnable December 17th, reads as follows: "Now, therefore, by the authority of the State of Minnesota, you, the said Duluth Gas and Water Company, are hereby commanded and required to be and appear before the Supreme Court of the State of Minnesota, at the rooms of said Court, in the capitol at St. Paul, Minn., on the 17th day of December, 1896, at 11 o'clock in the forenoon, and then and there respond to said information and this writ, and show cause by what warrant or alleged right you claim to have, use and enjoy the rights, privileges and franchises in said information described, and to show cause, if any you have, why said rights, privileges and franchises, whether granted by the Legislature of said State, or by the City of Duluth, and each and every of them, should not be adjudged and decreed forfeited to said State for wilful abuse and improper neglect, and why said respondent Company should not be entirely excluded therefrom, and why said Corporation should not be dissolved, and why this Court should not appoint a receiver of *all* the property of said corparation, to take an account and make distribution of said property among the creditors of said corporation, and also then and there to abide such order or direction, if any, as this Court may make in the matter."

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THE City Council, of Newport News, Va., has granted the franchise asked for by the projectors of the Newport News Gas, Fuel and Power Company. The main provisions of the ordinance were printed last week on page 816.

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THE plant of the Framingham Gas, Fuel and Power Company, of South Framingham, Mass., is being enlarged and improved.

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MAYOR WARNER, of Rochester, N. Y., has vetoed the resolution of the Board of Education of that city, awarding a contract for the lighting of the Free Academy by incandescent electric lamps to the Citizens Light and Power Company. The contract was to run for one year, and the contract price was $649 per annum, the number of lamps to be 433. The concluding paragraph of the veto is appended: "Rather than to submit to such an increase in the cost the Board might better return to the old system of lighting the Free Academy by gas, which could be done for from $250 to $275 per year. * * *."

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ON the basis that the figures forwarded us by our correspondent are correct, it does not appear that the Company was likely to become overenriched from the profits of the contract in dispute.

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AT the annual meeting of the Vallejo (Cal.) Gas Light Company the following officers were chosen: Directors, F. R. Devlin, S. J. McKnight, S. G. Hilborn, R. J. R. Aden and G. W. Wilson; President, S. G. Hilborn; Vice-President, R. J. R. Aden; Secretary, G. W. Wilson.

AT the annual meeting of the Gilroy (Cal.) Gas Light Company the retiring officers were re-elected.

A SUIT was filed about a fortnight ago in the Third District Court of Utah by the American Gas and Fuel Company against the Salt Lake and Ogden Gas and Electric Company, in which it is alleged that on February 11th, 1895, the plaintiff and defendant entered into a contract by which it was stipulated that the plaintiff, for a consideration of $15,000, would deliver to the defendant all the natural gas that the gas wells near Lake Shore, in Davis county, Utah, and all other wells which might be sunk by the plaintiff would produce within the next 10 years, for the sum and price of 35 per cent. of the gross receipts for which the natural gas may from time to time be sold to the consumers. Fifty cents per 1,000 cubic feet was the selling price of the gas, and the plaintiff alleges that it furnished 35,000,000 cubic feet of gas, and that 35 per cent. of the price of the same amounts to $6,125, for which sum judgment is prayed. For a second cause of action it is alleged that the defendant Company built a very defective pipe line from Salt Lake City to the gas wells, and on account of said pipe line being of such character, 50,000,000 cubic feet of gas supplied by the plaintiff escaped and was lost, to the plaintiff's damage in the sum of $25,000, for which sum judgment is prayed.

THEY had a parade, with torchlight accompaniment, one evening this month in Webster, Mass. The local artificial lighting concern is known as the Webster Electric Company, which operates in connection with its electric plant a small coal gas works. When the parade was started the Company had 14,000 cubic feet of gas in the holder; when the parade was at an end—the time occupied between beginning and end of the "march" was 70 minutes—the holder was flat, and every gas burner in Webster was shut off. The Company, however, established a "record" for maximum gas sendout in Webster, both as to quantity and speed.

THE Syracuse *Standard* is our authority for the statement that one of the four Republican Assemblymen elected to represent Onondaga county, N. Y., in the next session of the New York Legislature, proposes to secure the passage of a bill reducing the gas rate in Syracuse to $1 per 1,000 cubic feet. Is it not time for the gas proprietors of the State to organize for the purpose of securing that protection for their business which would result from the appointment of a commission similar to that which regulates the gas industry of Massachusetts?

THE Court of Revision, after hearing the appeal of the Ottawa (Can.) Gas Company for a correction of the sums at which its property was assessed for purposes of taxation for 1897, decided that the mains should be valued at $30,000, instead of $50,000; that the buildings should be valued at $50,000, instead of $60,000; and that the land should be valued at the original estimate—$2,400.

## The Absolute Zero.

*Engineering* says that the first suggestion of the existence of an absolute zero of temperature was derived from a consideration of the properties of perfect gases, these being defined as bodies, obeying accurately the laws of Guy Lussac and of Boyle and Marriott. With such bodies the volume under constant pressure is, according to these laws, directly proportional to the absolute temperature. Hence, if it were possible to deprive such a gas of all its heat it would, imitating the famous Boojum Snark, "swiftly and silently vanish away," and the grand principle of the conservation of matter would be upset. No gas is, however, known which does follow these laws through any wide range.

Some gases, such as hydrogen, under quite moderate pressures and temperatures, are, as Regnault expressed it, "more than perfect," whilst with others the deviation is in the opposite direction. One reason for this lies in the fact that even at the absolute zero of temperature matter cannot be destroyed, and the molecules, though touching each other, must occupy some space, if only a small one; and a second cause of the deviation is to be found in the fact that even in the gaseous state these molecules have a certain attraction for each other, thus tending to reduce the volume below what it otherwise should be. This mutual attraction naturally gets the fullest scope for its exercise at low temperatures and high pressures, so that, instead of the usual law $p\ v = c\ T$, where $p$ = pressure, $v$ = equal volume, $c$ a constant, and T the absolute temperature, we should really write $\left(p + \frac{a}{v^2}\right)(v - b) = c\ T$. The differences between the two equations are by no means insignificant, even at pressures of as low as 50 atmospheres, and ordinary temperatures, and at the absolute zero the new equation shows the volume to be $b$, instead of zero, as with the older form. The term $\frac{a}{v^2}$ represents the mutual attraction of the molecules for each other, and the equation still holds even when the body passes into the liquid state. Professors Dewar and Fleming have recently called attention to the fact that the absolute zero of temperature is also in another way a critical point in the behavior of matter. Thus all pure metals appear to become perfect conductors of electricity at this point. The curves drawn, showing the specific resistance of a pure metal and its absolute temperature, always appear to cut the line of no resistance in the neighborhood of the absolute zero. Like the above laws for gases, this statement is perhaps only an approximation to the truth, but it is apparently a very close one. It further follows that at this temperature all pure metals become perfectly opaque, and though observations with the X-rays have yet to be made, this deduction has, within limits, been experimentally verified. Alloys, on the other hand, would seem in general to retain at zero a large fraction of their conductivity at ordinary temperatures. In fact, extremely minute impurities in a metal are sufficient to prevent it following the general law above given. Thus of four samples of bismuth, all supposed to be chemically pure, only one, which was, it appears, prepared electrolytically, appeared to be a perfect conductor when totally deprived of heat. The magnetic properties of metals are also greatly affected at low temperatures. In general the magnetism is increased as the temperature is reduced, but 19 per cent. nickel steel is a notable exception, the reverse being the case with it. The mechanical strength of iron and steel, again, is at — 182° C. near double what it is at 0°. C., though the law of this increase does not seem to have been investigated as yet, so that it is impossible to form any ideas as to the strength of these metals at the absolute zero point.

## Dr. L. Mond on Industrial Chemistry.

The *Journal of Gas Lighting* "notes" that the address delivered by Dr. Ludwig Mond, as President of the Chemistry Section of the British Association meeting in Liverpool, was strictly confined to the history of the manufacture of chlorine. Yet it was well worth reading by others than those connected with the chlorine industry, as it throws much light upon many highly intetesting points of theoretical and practical chemistry. In narrating the history of chlorine, Dr. Mond described the Weldon process, which results, among other things, in the production of what is now everywhere known as "Weldon Mud"—the peroxide of manganese. It is curious to note that, as a chemist, Dr. Mond readily admitted that Mr. Walter Weldon's success in modifying a process proposed thirty years before for the recovery of the manganese that had been used in the manufacture of chlorine, was probably due to the fact of his not being a chemist. Mr. Gossage, in 1837, proposed to treat the residual liquors of this manufacture by lime, and to oxidize the resulting protoxide of manganese by bringing it into frequent and intimate contact with atmospheric air. The idea, with several patented modifications of it, was tried in various places unsuccessfully.

Mr. Weldon, however, did succeed because, not being a chemist, he did not add the equivalent quantity of lime to his liquor to precipitate the manganese, but used an excess. Though no chemist at this time, Mr. Weldon soon made himself one, being a man of genius and of great perseverance; and he studied every detail of the reaction, with the utmost tenacity, until he had thoroughly established how this satisfactory result could be obtained on the largest scale with the greatest regularity and certainty. He even went further, and added considerably to our theoretical knowledge of the character of manganese peroxide and similar peroxides, by showing that these compounds possess the character of weak acids. Dr. Mond concluded his address with a reference to the production of chlorine by electrolysis; stating that though the theory was worked out by Faraday, it has taken all this time for the discovery to develop into the modern magneto-electric machine, capapable of producing electricity in sufficient quantity to make it available for chemical operations on a large scale; for it must be kept in mind that an electric installation sufficient to light a large town will only produce a very moderate quantity of chemicals. Dr. Mond declared his disbelief that the easiest way of effecting chemical changes will be found in transforming heat and chemical affinity into electricity, tearing up chemical compounds by this medium in order that their constituents may re-combine in the forms we require.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, NOV. 30, 1896.

## The Market for Gas Securities.

Consolidated sold up to 168 during the week, and then reacted to 164½, which figure was recorded at noon of the 18th. Later the same day the price advanced to 166. To-day (Friday) the opening was made at 163 to 165, with an unsettled feeling respecting the shares. Shortly after noon the Directors announced the declaration of the usual quarterly dividend of 2 per cent., payable December 15th. Transfer books close December 1st, to be reopened on the 16th. No announcement of anything in connection with the progress of the reported scheme for consolidating the interests of at least three of the Companies was made, other than that such consolidation has not been accomplished. We submit, however, that Consolidated is worth purchasing. East River common is 44 to 45½, and all the other city shares are firm, at better prices than prevailed a week ago.

Brooklyn Union gas is 92 to 94, ex-dividend of 3 per cent., and the bonds are steady at last week's quotations. The executive organization of the Company has been perfected, the officers selected being the following: President, General James Jourdan; Vice-President, H. H. Rogers; Secretary, Edwin Ludlam; Treasurer, E. R. Chapman. The dividend is payable December 1st.

Chicago gas is weaker, the opening to-day having been made at 73⅝ to 73¾. Of course, this is ex-dividend of 1½ per cent. Consolidated, of Baltimore, is reported at 63½ to 64½, ex-dividend (semi-annual) of 2½ per cent.

Bay State shows no change from the figures of a week ago, and although the feeling respecting the outcome of the legal proceedings over the newest application for a receiver is not all one way, we nevertheless believe that Bay State is worth buying at the market. The Indiana group are in demand, and Laclede are also being marketed at a sharp decline from the figures of last week.

## Gas Stocks.

**Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.**

35 WALL ST., NEW YORK CITY.

Nov. 30.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

| *N. Y. City Companies.* | *Capital.* | *Par.* | *Bid.* | *Asked.* |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 163 | 165 |
| Central | 500,000 | 50 | 150 | .. |
| " Scrip | 220,000 | .. | 100 | . |
| Equitable | 4,000,000 | 100 | 210 | 215 |
| Bonds, 6's | 1,000,000 | 1,000 | 105 | .. |
| " 1st Con. 5's | 2,300,000 | 1,000 | 114 | . |
| Metropolitan Bonds | 658,000 | .. | 108 | 112 |
| Mutual | 3,500,000 | 100 | 240 | .. |
| " Bonds | 1,500,000 | 1,000 | 100 | 102 |
| Municipal Bonds | 750,000 | . | .. | . |
| Northern | 150,000 | 50 | 79 | 80½ |
| " Bonds | 150,000 | 1,000 | .. | 98 |
| New York and East River | 5,000,000 | 100 | 44 | 45½ |
| Preferred | 2,000,000 | 100 | 74 | 76 |
| Bonds 1st 5's | 3,500,000 | 1,000 | 104 | 105 |
| " 1st Con. 5's | 1,500,000 | .. | 94½ | 95½ |
| Richmond Co., S. I. | 348,650 | 50 | 50 | .. |
| " Bonds | 100,000 | 1,000 | .. | .. |
| Standard | 5,000,000 | 100 | 85 | .. |
| Preferred | 5,000,000 | 100 | 107 | 110 |
| Bonds, 1st Mortgage, 5's | 1,500,000 | 1,000 | 109½ | .. |
| Yonkers | 299,650 | 50 | 180 | .. |
| *Out-of-Town Companies.* | | | | |
| Brooklyn Union | 15,000,000 | 100 | 92 | 94x |
| " " Bonds (5's) | 15 000,000 | 1,000 | 105½ | 106¼ |
| Bay State | 5,000,000 | 50 | 10½ | 11 |
| " Income Bonds | 2,000,000 | 1,000 | .. | 45 |
| Boston United Gas Co.— | | | | |
| 1s Series S. F. Trust | 7,000,000 | 1,000 | 80 | 83 |
| 2d " " " | 3,000,000 | 1,000 | | 76 |
| Buffalo Mutual | 750,000 | 100 | 125 | .. |
| " Bonds | 200,000 | 1,000 | 95 | 100 |
| Central, San Francisco | 2,000,000 | .. | 95 | .. |
| Chicago Gas Co. | 25,000,000 | 100 | 73⅝ | 73¾ |
| Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds. | 7,650,000 | 1,000 | 94 | 94¼ |
| Columbus | 1,069,000 | .. | .. | 65 |
| 1st Mortgage | 1,085,000 | .. | .. | 96 |
| Consumers, Jersey City | 2,000,000 | 100 | 75 | 85 |
| " Bonds | 600,000 | 1,000 | 99 | 101 |
| Cincinnati G. & C. Co. | 7,000,000 | 100 | 201 | 202 |
| Consumers, Toronto | 1,600,000 | 50 | 184½ | 187 |
| Capital, Sacramento | 500,000 | 50 | .. | 30 |
| Bonds (6's) | 150,000 | 1,000 | .. | .. |
| Consolidated, Baltimore | 1,000,000 | 100 | 63½ | 64½ |
| Mortgage, 6's | 3,600,000 | .. | 107 | 107½ |
| Chesapeake, 1st 6's | 1,000,000 | .. | .. | .. |
| Equitable, 1st 6's | 910,000 | .. | .. | .. |
| Consolidated, 1st 5's | 1,490,000 | .. | .. | .. |
| Detroit | 4,000,000 | .. | 32 | 33 |
| " Con. Bonds | 4,312,000 | .. | .. | 82 |
| Equitable Gas & Fuel Co., Chicago, Bonds | 2,000,000 | 1,000 | .. | 101 |
| Fort Wayne | 2,000,000 | .. | 84 | 86 |
| " Bonds | 2,000,000 | .. | 85 | 90 |
| Hartford | 750,000 | 25 | .. | 145 |
| Indianapolis | 2,000,000 | .. | 128 | 133 |
| " Bonds, 6's | 2,650,000 | .. | 103 | 105 |
| Jersey City | 750,000 | 20 | 180 | .. |
| Lafayette Gas Co., Ind. | 1,000,000 | 100 | 82 | 86 |
| Bonds | 1,000,000 | 1,000 | 85 | 90 |
| Louisville | 2,570,000 | 50 | .. | .. |
| Laclede, St. Louis | 7,500,000 | 100 | 23½ | 24½ |
| Preferred | 2,500,000 | 100 | 75 | .. |
| Bonds | 9,084,400 | 1,000 | 94½ | 95 |
| Little Falls, N. Y. | 50,000 | 100 | .. | 100 |
| Bonds | 25,000 | .. | .. | 100 |
| Montreal, Canada | 2,000,000 | 100 | 200 | . |
| Newark, N. J., Gas Co. | 1,000,000 | .. | 93 | 98 |
| Bonds, 6's | 4,000,000 | .. | 123 | .. |
| New Haven | 1,000,000 | 25 | 225 | .. |
| Oakland, Cal. | 2,000,000 | .. | 52 | 53¼ |
| " Bonds | 750,000 | .. | .. | .. |
| Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage | 20,100,00 | 1,000 | .. | 108 |
| 2d " | 2,500,000 | 1,000 | 104 | 105 |
| Peoples, Jersey City | 500,000 | 50 | .. | 175 |
| Paterson, N. J. | ..... | 25 | 99 | 102 |
| Rochester Gas & Elec. Co. | 2,150,000 | 50 | .. | .. |
| Preferred | 2,150,000 | 50 | 88 | .. |
| Consolidated 5's | 2,000,000 | .. | 87½ | 90 |
| San Francisco, Cal. | 10,000,000 | 100 | 97¾ | 98¼ |
| St. Paul Gas Light Co. | 1,500,000 | 100 | 67½ | 70 |
| 1st Mortgage, 6's | 650,000 | .. | 84 | 87 |
| Extension, 6's | 600,000 | .. | . | .. |
| General Mortgage, 5's | 2,400,000 | . | 88 | 90 |
| Syracuse, N. Y. | 500,000 | 25 | .. | .. |
| Washington, D. C. | 2,000,000 | 20 | 250 | |
| Western, Milwaukee | 4,000,000 | 100 | 60 | 65 |
| Bonds, 5's | 3,556,000 | . | 90 | 93 |
| Wilmington, Del. | 500,000 | 50 | 180 | 182 |

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## DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, Nov. 12, 1896.

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable on Dec. 10, 1896, to stockholders of record at the close of business Nov. 30. The Transfer books of the preferred stock will be closed from Dec. 1 to Dec. 10, both inclusive. Checks will be mailed.

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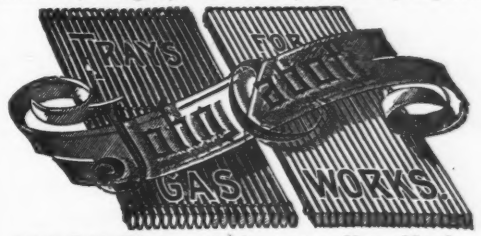


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For Cutting Cast, Wrought Iron, Gas & Water Pipes.
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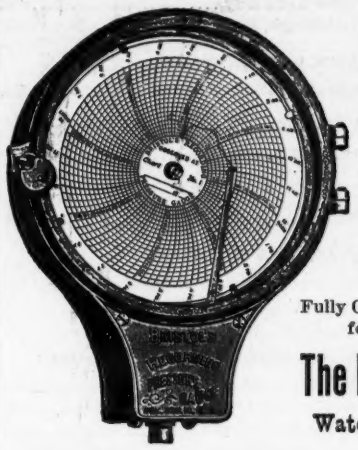

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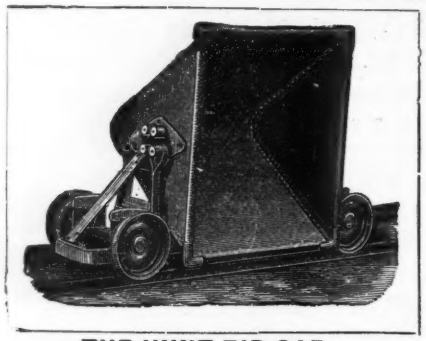

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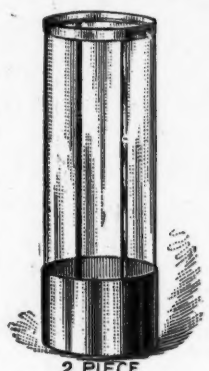

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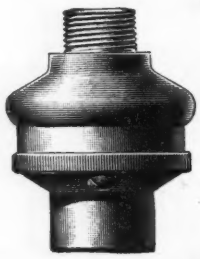

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## To be He'd at MADISON SQUARE GARDEN, NEW YORK,

**Two Weeks, Beginning January 25, 1897.**

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**The Gas Associations have Appointed the Following Representatives:**

**W. M. EATON,** Michigan Gas Asso. **J. A. BRITTON,** Pacific Coast Gas Asso. **IRVIN BUTTERWORTH,** Ohio Gas Light Asso. **GEO. T. THOMPSON,** Western Gas Asso.

## PROSPECTUS.

THE object of the **Gas Exposition** is to bring together a collection of gas apparatus and appliances of every description, for the two-fold purpose of affording the general public and the gas engineer an opportunity to study the developments that have taken place in the gas industry during recent years. In submitting the plan of the Exposition to those who may feel an interest in the project, the management would call the attention of manufacturers of supplies of every description, entering into the manufacture of gas, to the great benefits which similar affairs have conferred on the industries of Great Britain, Germany and France, in which countries the exhibitions of gas appliances are held with recurring frequency. The creation of a healthy public sentiment in favor of gas is one of the first aims of large numbers of foreign gas companies.

## MADISON SQUARE GARDEN.

In the selection of New York for the inauguration of an enterprise of this character, it is believed that no mistake has been made. In this city the Madison Square Garden is looked upon as one of the great show places of the metropolis; it contains within its walls the requisite space for the proper display of an almost unlimited amount of product, without which an affair of this kind cannot hope for the stamp of public approval—hence the selection of this great building for the inauguration of the gas industries exposition during the two weeks beginning January 25, 1897.

The greater New York contains a resident population of 3,000,000 people. Within a radius of 50 miles of Madison Square Garden live 4,500,000 people; reliable statistics show that an average of fully 100,000 strangers visit New York every day in the year. Thus it will be seen that the gas exposition will draw from a population of fully 6,000,000. In this connection it ma be stated that every effort will be put forth that ingenuity can devise to thoroughly advertise the exposition, and create a desire in the minds of the public to come to the show; and once within its portals the dazzling brilliancy there abounding, coupled with the many attractive and instructive exhibits, will cause the visitor to wish to come again.

It is expected that cooking demonstrations will be a feature of the exposition. The lecture and concert hall, situated conveniently near the great amphitheater, in which the exposition is to take place, affords seating room for 1,200 to 1,400 people. The most experienced and talented ladies obtainable will be selected for this feature of the affair, which must prove one of the show's greatest attractions; not only for the housewives who may be attracted to it, but for gas managers, who will thus have an opportunity to study the advantages these gas cooking demonstrations offer as one of the means at hand for the education of people in the uses of gas.

# THE "VULCAN" GAS HEATERS
## And Appliances

No. 234. Design Patented.

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Take with the Public because they are
**Well Made, Well Finished and Well Known.**

**GAS LOGS, RADIATORS,
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Everything for Gas
that is made!**

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Candy Stoves, Water Heaters,
etc., etc.

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Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

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# INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

*The President of the United States,*

TO A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No. 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen, under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL) JOHN A. SHIELDS, Clerk.

(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages. The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

**WELSBACH LIGHT COMPANY.**

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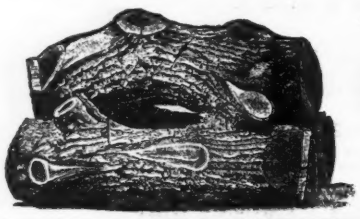
## Best in the World.

Best Constructed, Finest Finished and Most Economical Gas Stoves Made. Send for Beautiful New Catalogue, just issued, and get our Prices before buying.



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**Their Construction and Arrangement,**

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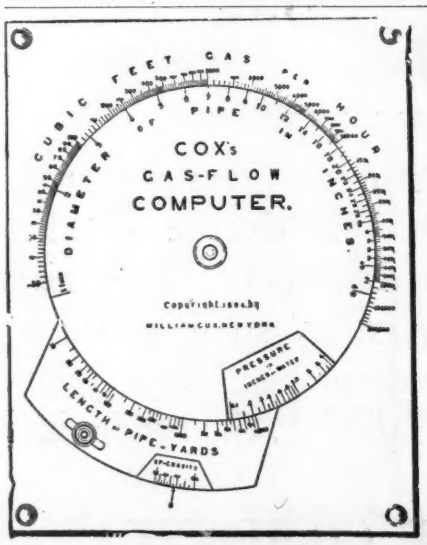


# Cox's Gas Flow Computer.

1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.01 to 10.0 inches of water, and any specific gravity from 0.40 to 1.00.

2. When the required discharge and the length of pipe are given, the diameter corresponding to any pressure is at once seen.

3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.

4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

It Prevents Errors and Saves Hours of Tiresome Calculations.

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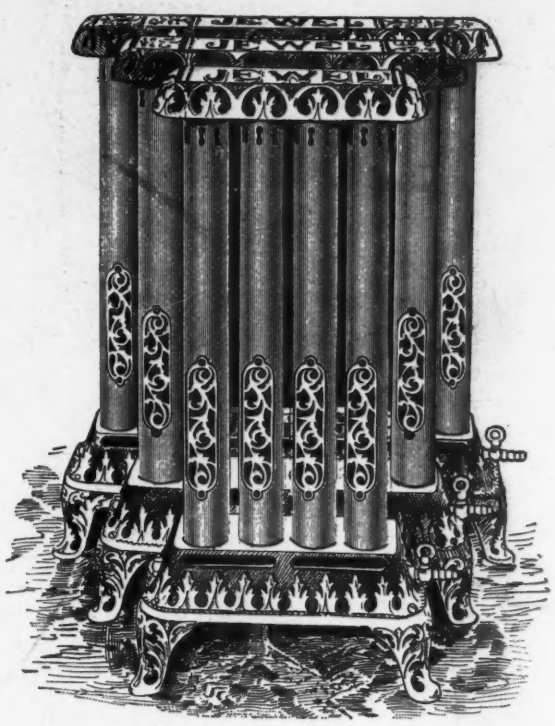


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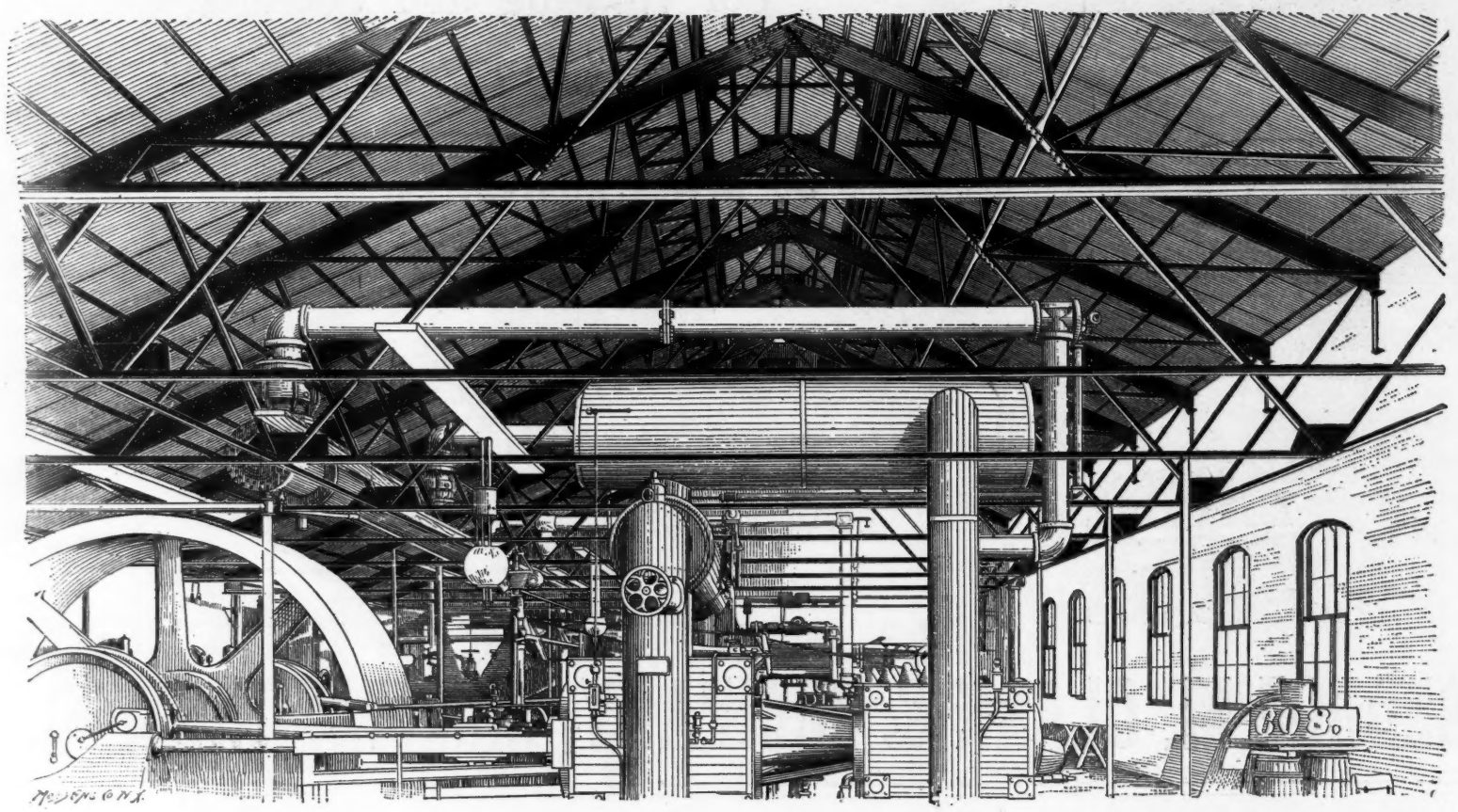

The above illustration is taken direct from a photograph, and shows an interior view of the Engine Room for the Narragansett Lighting Co., at Providence, R. I. This plant is probably one of the best electric lighting plants in the United States. The Roofs of the entire plant were designed and built by us of iron, covered with our Patent Anti-Condensation Corrugated Iron Roof Covering, guaranteed as absolutely fireproof; and we further guarantee that the Corrugated Iron will not drip in the coldest weather.

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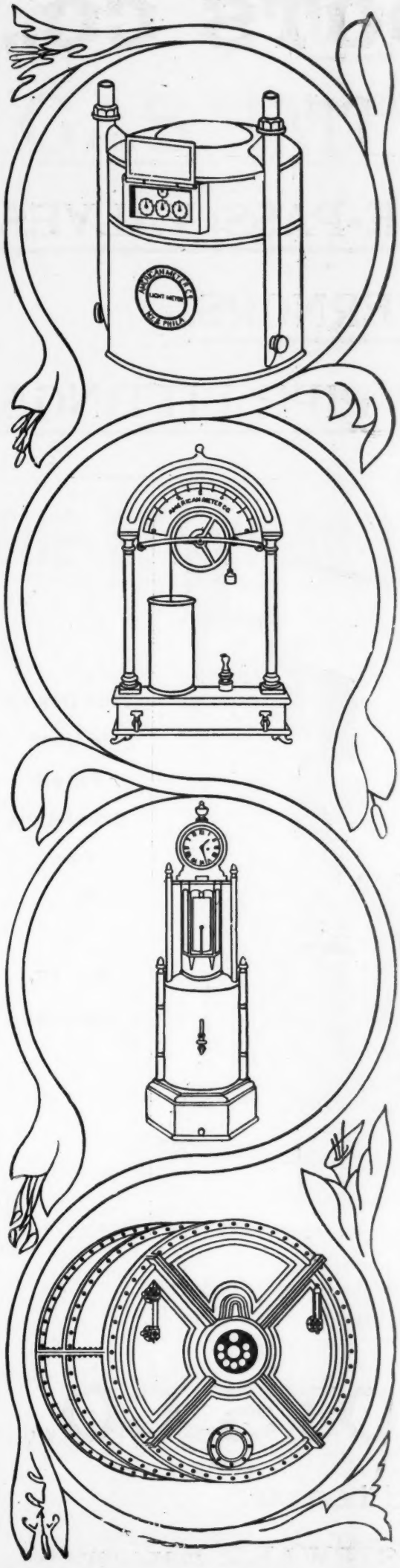

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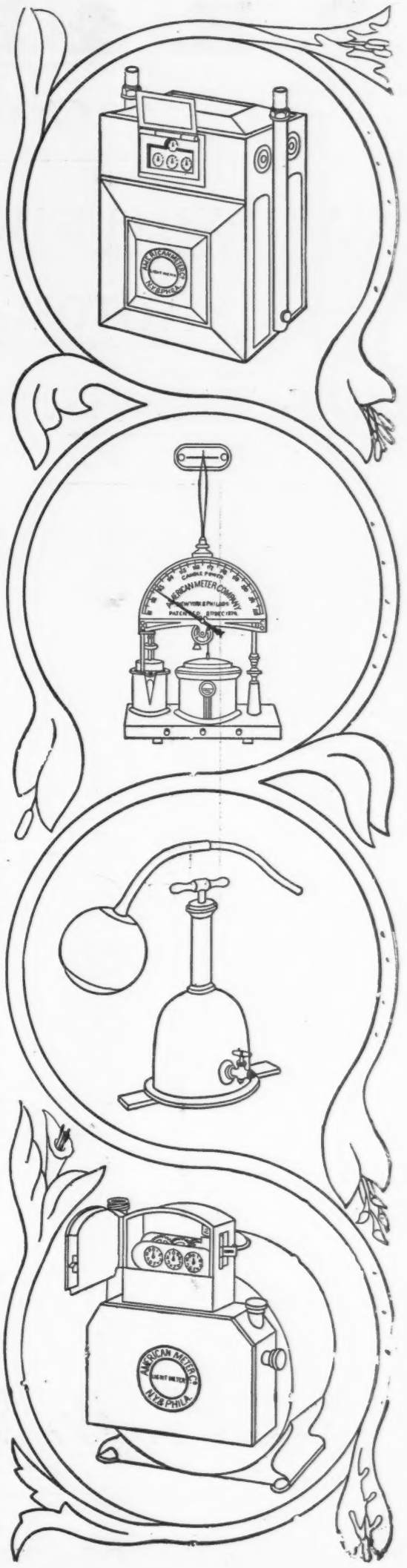
## PUBLIC LIGHTING TABLE.

### DECEMBER, 1896.

| Day of Week. | Date. | Table No. 1. Following the Moon. Light. | Extinguish. | Table No. 2. New York City. All Night Lighting. Light. | Extinguish. |
|---|---|---|---|---|---|
| | | | | P.M. | A.M. |
| Tue. | 1 | 5.00 PM | 6.10 AM | 4.20 | 6.10 |
| Wed. | 2 | 5.00 | 6.10 | 4.20 | 6.10 |
| Thu. | 3 | 5 00 | 6.10 | 4.20 | 6.15 |
| Fri. | 4 | 5.00 NM | 6.10 | 4.20 | 6.15 |
| Sat. | 5 | 5.00 | 6 10 | 4.20 | 6.15 |
| Sun. | 6 | 5.00 | 6.10 | 4.20 | 6 15 |
| Mon. | 7 | 5.00 | 6.10 | 4.20 | 6.15 |
| Tue. | 8 | 5.00 | 6.10 | 4.20 | 6.15 |
| Wed. | 9 | 9.00 | 6.10 | 4.20 | 6.15 |
| Thu. | 10 | 10.00 | 6.10 | 4.20 | 6.20 |
| Fri. | 11 | 11.00 FQ | 6.10 | 4.20 | 6.20 |
| Sat. | 12 | 12.00 | 6.10 | 4.20 | 6.20 |
| Sun. | 13 | 1.00 AM | 6.20 | 4.20 | 6.20 |
| Mon. | 14 | 2.00 | 6.20 | 4.20 | 6.20 |
| Tue. | 15 | 3.00 | 6.20 | 4.20 | 6.20 |
| Wed | 16 | 4.10 | 6.20 | 4.20 | 6.20 |
| Thu. | 17 | 5 10 | 6.20 | 4.20 | 6.20 |
| Fri. | 18 | No L. | No L. | 4.20 | 6.20 |
| Sat. | 19 | No L. FM | No L. | 4.20 | 6.20 |
| Sun | 20 | No L. | No L. | 4.20 | 6.20 |
| Mon. | 21 | 5.10 PM | 7:00 PM | 4.20 | 6.20 |
| Tue. | 22 | 5.10 | 8.10 | 4.20 | 6 20 |
| Wed. | 23 | 5.10 | 9.20 | 4.20 | 6.20 |
| Thu. | 24 | 5.10 | 10.30 | 4.20 | 6 25 |
| Fri. | 25 | 5.10 | 11.40 | 4.20 | 6.25 |
| Sat. | 26 | 5.10 LQ | 12.30 AM | 4.20 | 6.25 |
| Sun. | 27 | 5.10 | 2.00 | 4.20 | 6 25 |
| Mon. | 28 | 5.10 | 3.20 | 4.20 | 6.25 |
| Tue. | 29 | 5.10 | 4.30 | 4.20 | 6.25 |
| Wed. | 30 | 5.10 | 6.20 | 4.20 | 6.25 |
| Thu. | 31 | 5.10 | 6.20 | 4.20 | 6.25 |

## TOTAL HOURS LIGHTING DURING 1896.

| By Table No. 1. | Hrs. Min. | By Table No. 2. | Hrs. Min. |
|---|---|---|---|
| January | 220.40 | January | 423.20 |
| February | 207.00 | February | 367 40 |
| March | 193.00 | March | 355.35 |
| April | 174.10 | April | 298.50 |
| May | 164.00 | May | 264.50 |
| June | 142.10 | June | 234.25 |
| July | 142.10 | July | 243.45 |
| August | 150.50 | August | 280.25 |
| September | 163.00 | September | 321.15 |
| October | 193.10 | October | 374.30 |
| November | 207.00 | November | 401.40 |
| December | 237.30 | December | 433.45 |
| Total, yr. | 2194.40 | Total, yr. | 4000.00 |



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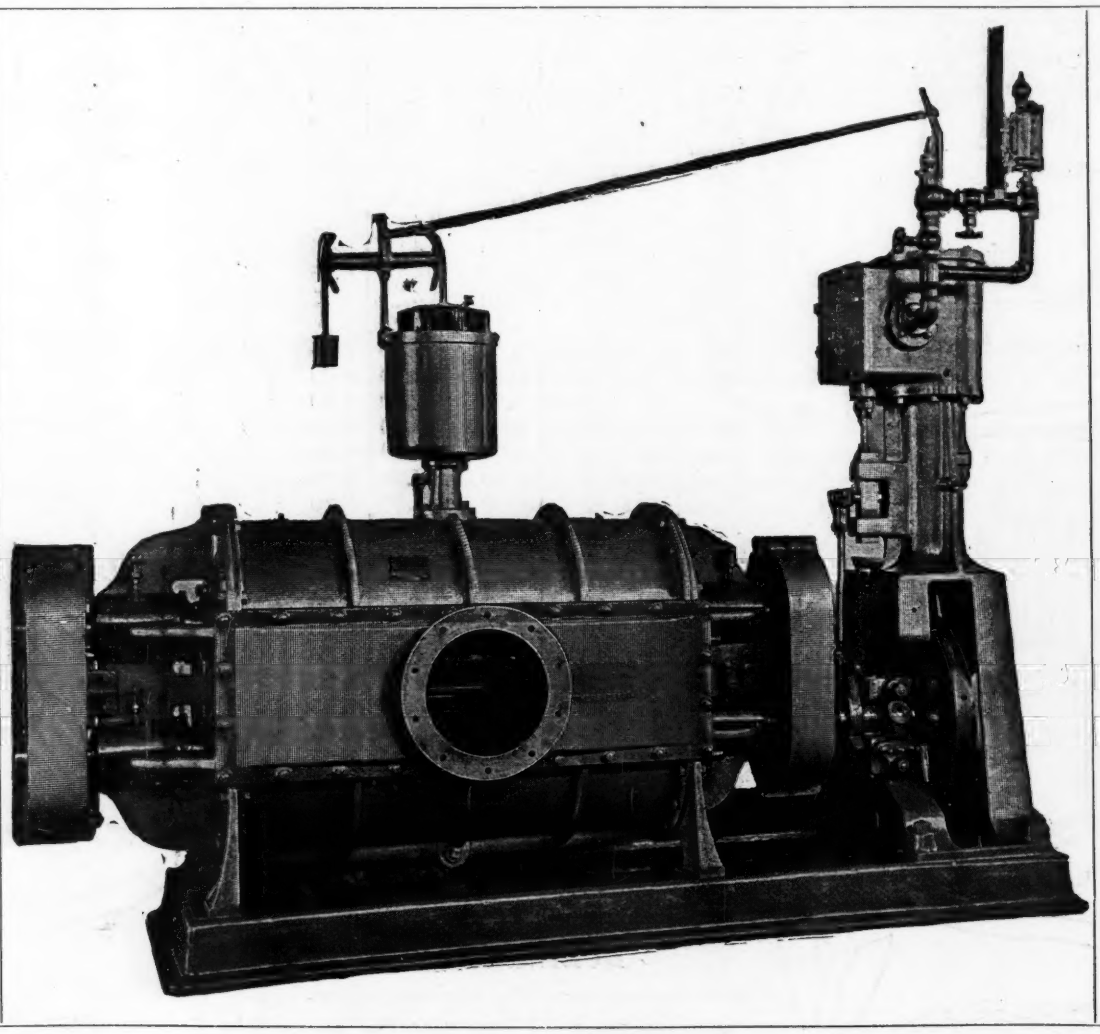
AUTOMATIC GAS GOVERNORS.

GAS VALVES. PIPE FITTINGS.

New Design of Direct Connected Engine and Exhauster on Same Bedplate.



This Design is Used for all Exhausters from No. 7 to No. 10, Inclusive.

**Write for Illustrated Catalogue.**
**Estimates submitted on application.**

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## DREXEL BUILDING, PHILA., PA.

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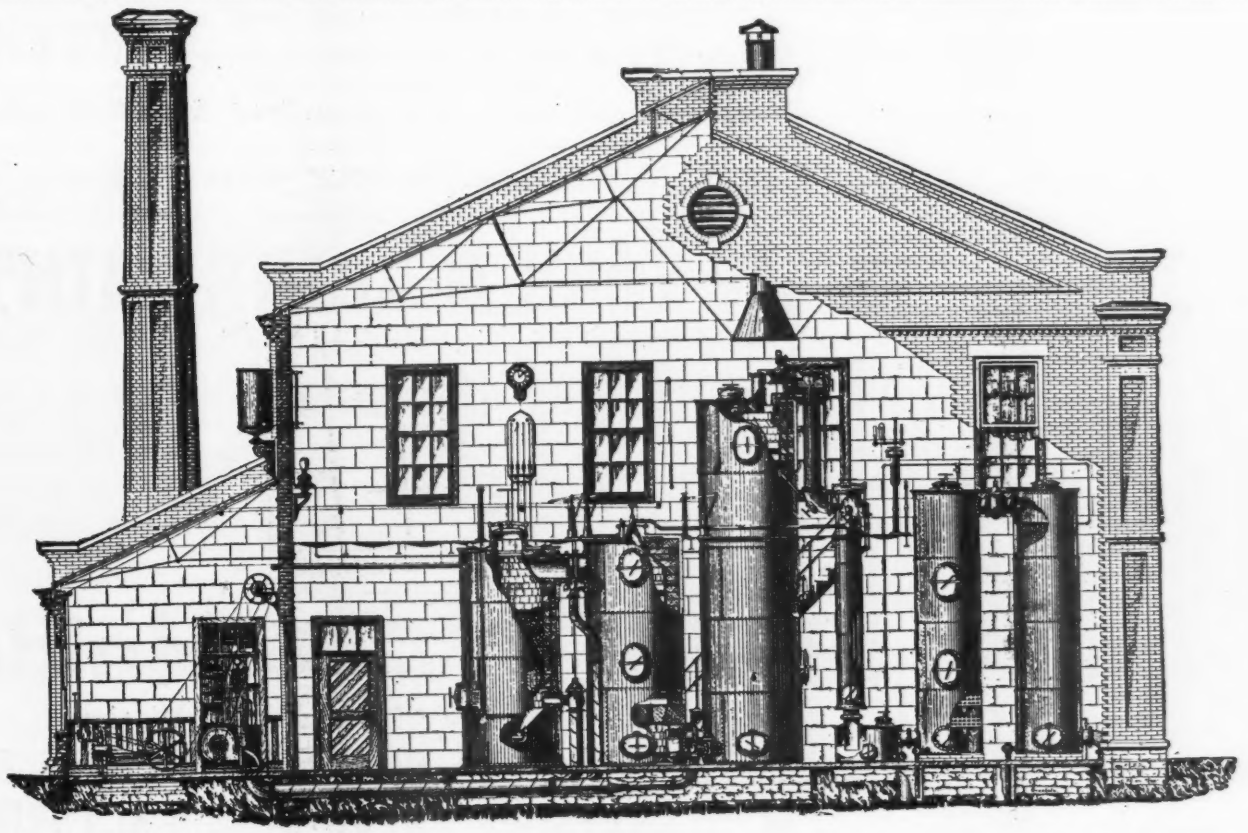
BUILDERS OF

## THE STANDARD LOWE WATER GAS APPARATUS.



Standard "Double Superheater" Lowe Apparatus, designed for the use of Naphtha, Crude Oil, or "Distillates."

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Water Gas Plants, either independent or auxiliary to Coal Gas Works, erected to meet any conditions. Apparatus designed to use any grade of Oil, and Anthracite Coal, or Gas House or Oven Coke.

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Improved Double Superheater Settings,
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Special Designs for Small Works.

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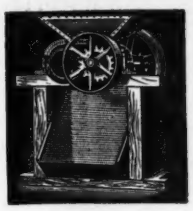

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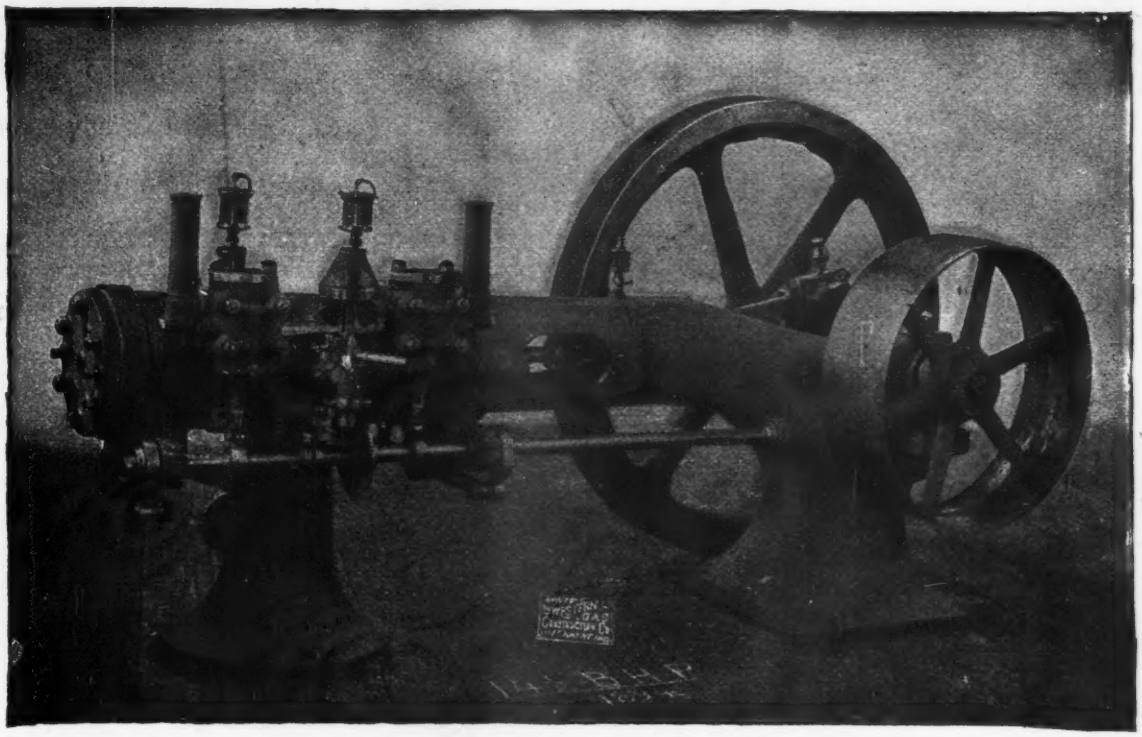

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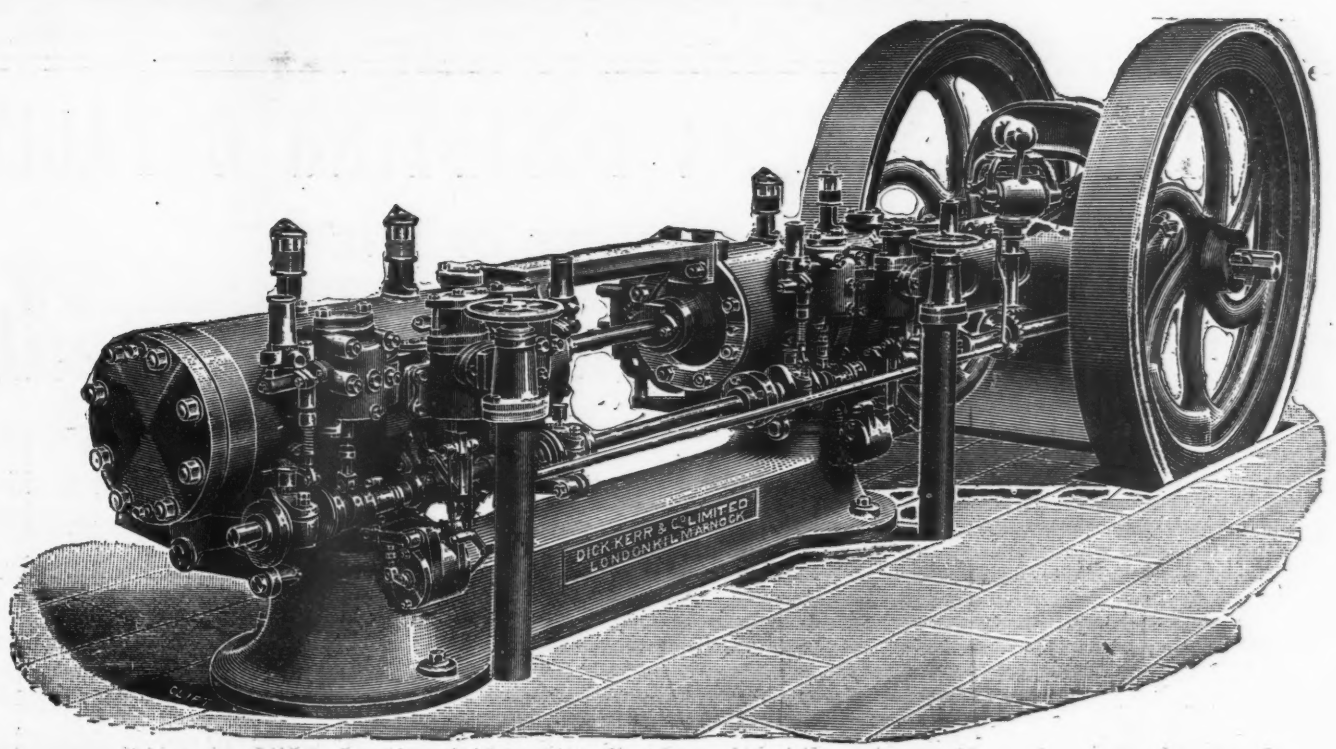


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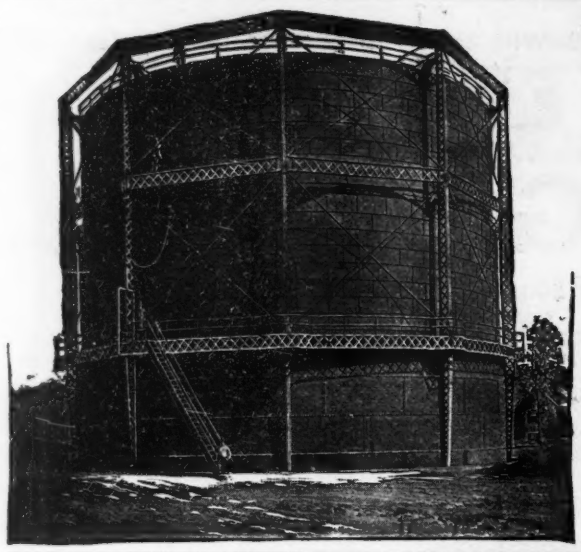

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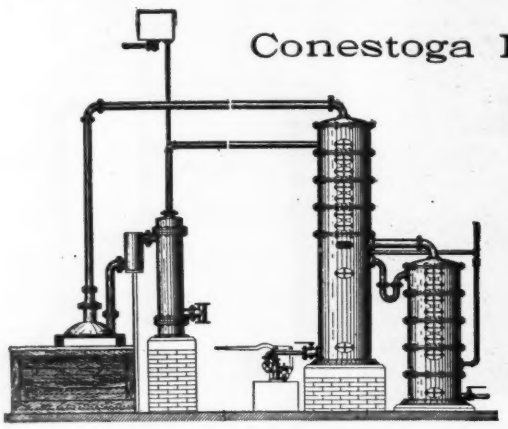

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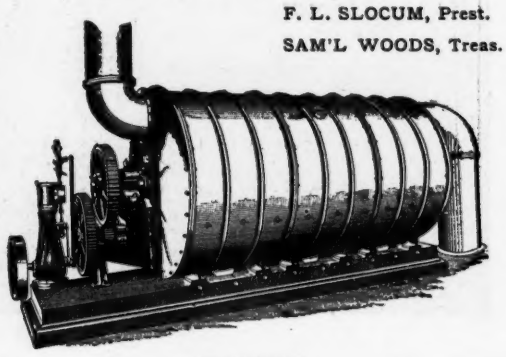

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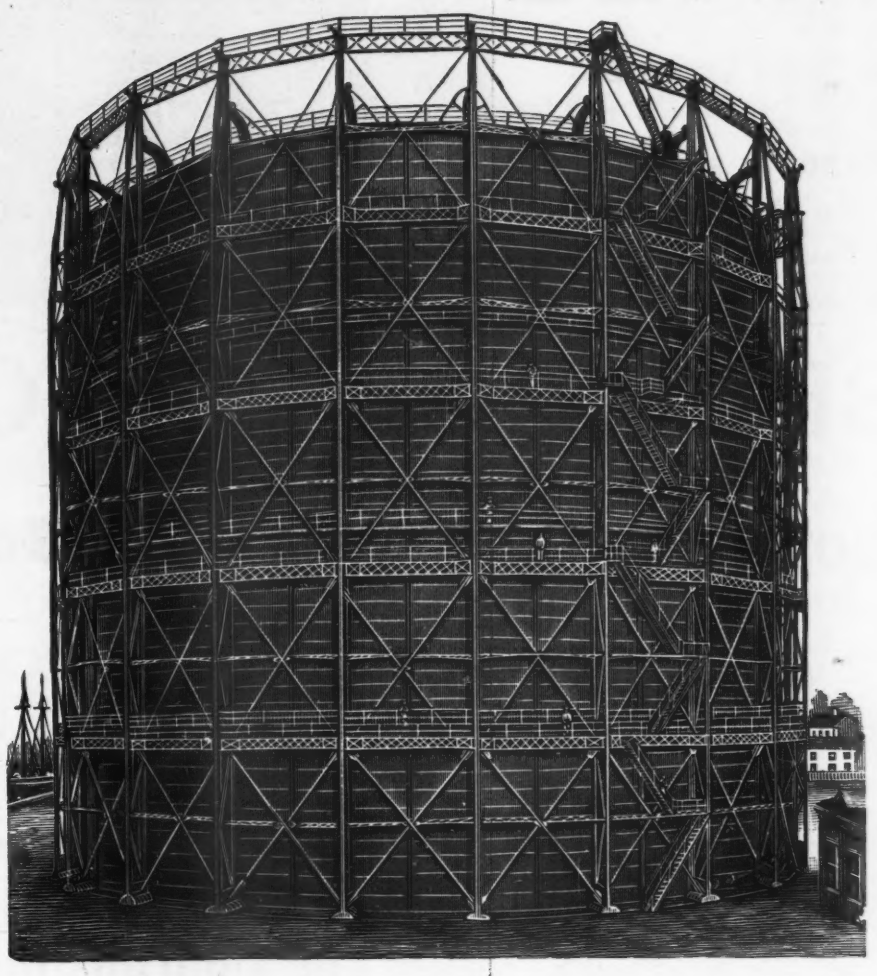

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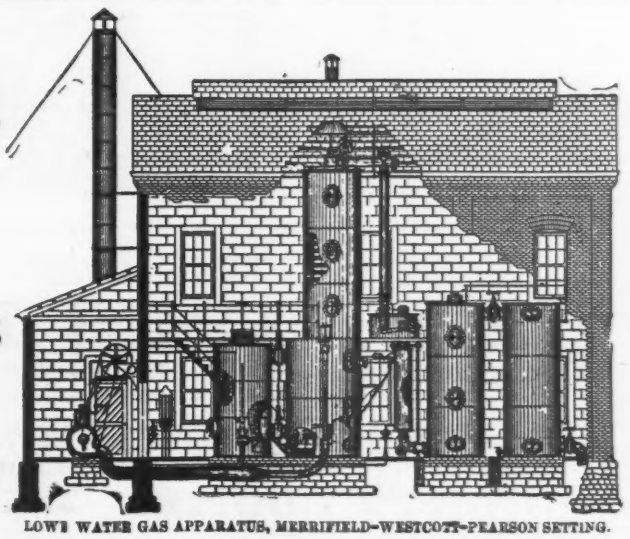

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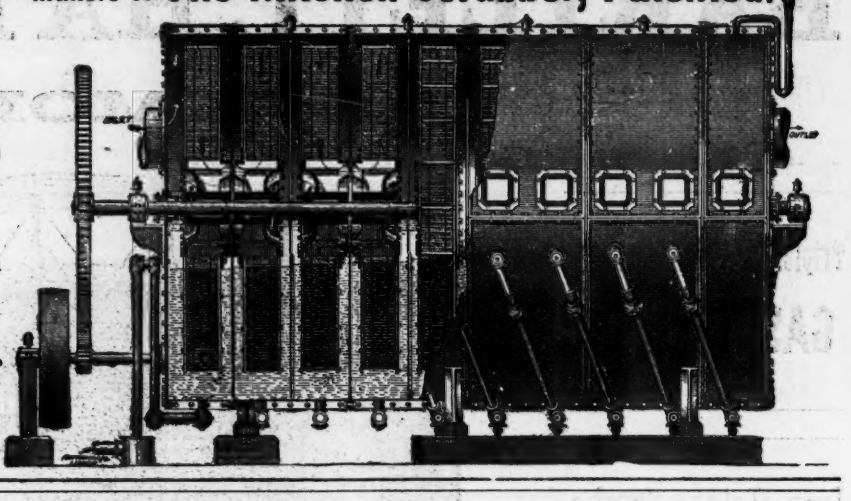

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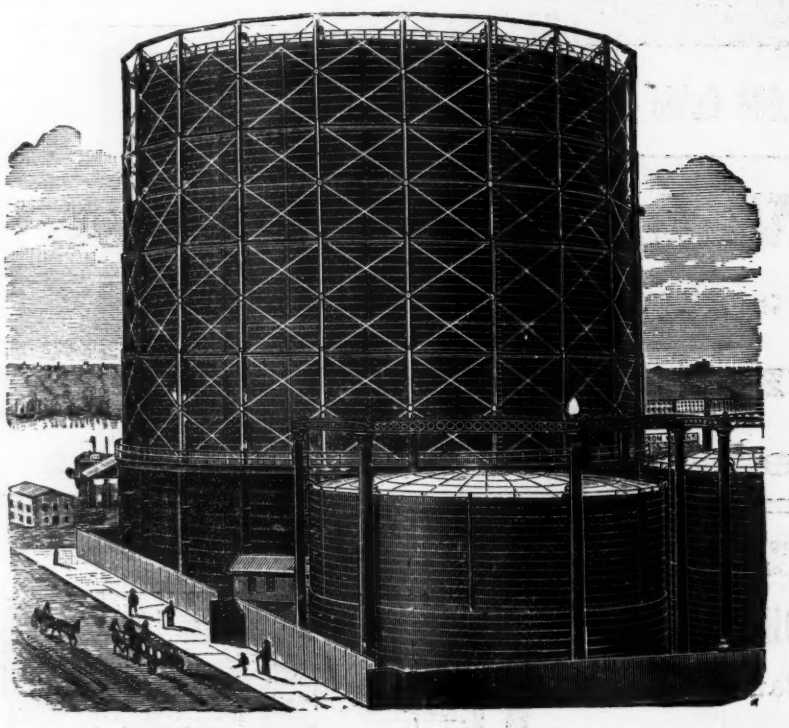

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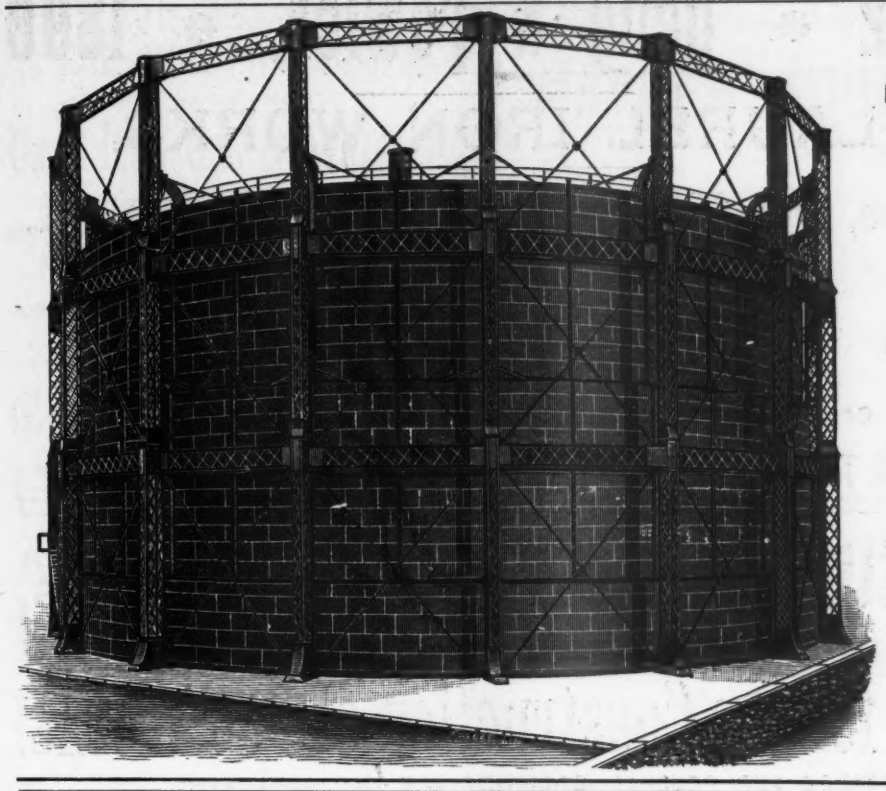

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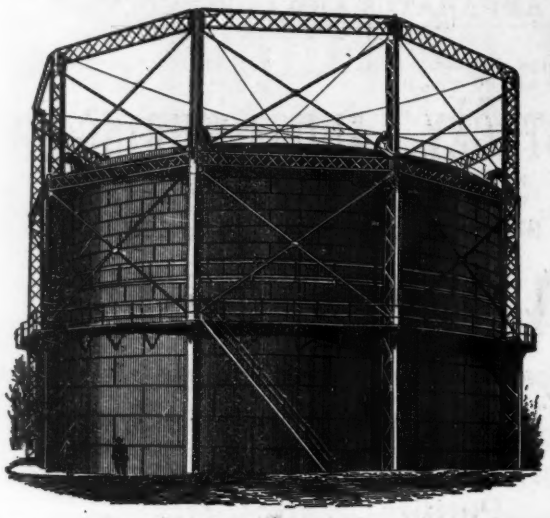

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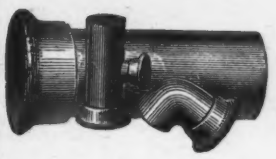

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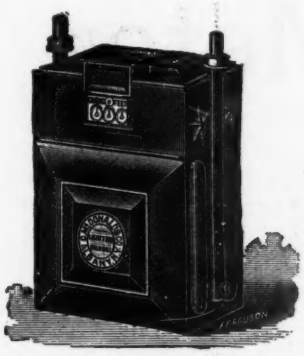

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